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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

SEPTEMBER 10-16.

International Foundry Congress:—International Foundry Congress at Prague.

SEPTEMBER 18-21.

Institute of Metals:—Silver Jubilee Autumn Meeting in Birmingham.

Australian Foundry Practice.

A unique event in the history of British foundry technology is scheduled to take place on September 6, when Mr. R. G. Russell, of Melbourne, will describe to the London Branch of the Institute of British Foundrymen an effort his firm has made to create on economical lines a small quantity production foundry for the manufacture of piston pots and rings. This will be the first time that an Australian—or, in fact, anyone from the Dominions except India—has had the courage to give to an English audience the benefit of personal experience. Moreover, he is to present a cinema film of his mechanised foundry. We have had the privilege of running through Mr. Russell's manuscript, and are so convinced of the interest it displays to home foundrymen, that we do not hesitate in saying that provincial foundrymen should make the trip to London to listen to this lecture. To say the description deals with a completely mechanised foundry handled by one man would be an exaggeration, but we have never yet encountered a case where a single moulder has been provided with a continuous conveyor all for himself. Then his story of the manufacture of single-cast piston rings brings a wealth of new notions to British audiences, as at the moment the manufacture of these castings can almost be regarded as a trade secret.

In the past the London Branch has been honoured by distinguished lecturers from France, Germany and Italy, yet we can assure our readers that the Paper to be given by Mr. Russell will be of equal, if not greater, interest than anything previously presented under similar circumstances. Considering that Mr. Russell's Paper has been prepared whilst he is on holiday, a debt of gratitude is already owing to him. Beyond saying that the Paper also covers the manufacture of aluminium pistons by the gravity die-casting process, we feel that to enter into any further details would be unfair to the lecturer.

We attach much importance to this Paper, as we believe it will make foundrymen in the Dominions and Colonies realise that we in the Old Country are only too anxious to have their co-operation in the furtherance of foundry technique. Their problems have often to be tackled in a way different from ours, and the co-operative study of successful solutions effected so remotely must throw light of an important character on metallurgy in general and foundry technology in particular.

Moreover, there has been a metamorphosis in the foundry-equipment business, and Great Britain is to-day in a better position to supply the needs of overseas foundries than ever before in its history. By making known his foundries' successes, ambitions and difficulties in the way that Mr. Russell is doing, he is thereby creating that mutual understanding which forms the best basis for satisfactory commercial transactions.

Among the Soviets.

The release of the two remaining engineers from Moscow, the big claims made by the Soviet Government on the results of the Five Year Plan, and the reports that foreign specialists are leaving the country because of their inability to get payments due to them made in their own currencies, have all brought Russian affairs very much into the news during the past few weeks. Speaking generally, the governors of the U.S.S.R. have undoubtedly taken the lead offered to them by Western industrial countries with respect to education and research, and are using it with an enthusiasm which far exceeds that found in the countries of its origin. As a recent observer, Mr. Julian Huxley has said: Russia is engaged on an enormous experiment and is seeking to remodel within a few decades the destinies of one-sixth of the habitable globe. The Five Year Plan is only an incident in a long series of plans; it is a symptom of a new spirit, the spirit of science introduced into politics and industry. In Great Britain one of the heaviest sufferers under the economy axe was scientific research. In Russia, in spite of a much lower economic standard, a far larger proportion of the national income is assigned to science than was the case with us during times of prosperity.

The Scientific Planning Department of the Supreme Economic Council, more or less equivalent to our Department of Scientific and Industrial Research, deals with the whole of industry, and with the great bulk of pure scientific work in physics, chemistry and engineering. They believe that all science is practical, and should be made to serve practical needs as thoroughly and as quickly as possible, but they also know that unless research deliberately disregards practical ends, it cannot in the long run bear practical fruit. They overcome the serious lag which most countries have in the application of science to practice very quickly. Our mode of industrial organisation, our development of the art of government as something which follows rather than leads public opinion, leaves us open to very grave handicaps in meeting a dictatorship which knows its own mind and does not hesitate ruthlessly to press forward with its own plans. The answer that we can make to such a dictatorship must depend on a high degree of public enlightenment and a recognition that, although a profit margin is essential to business as we know it, the immediate profit margin is a very short view on which to build and conduct an industry.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Me Fecit 1569.

To the Editor of The Foundry Trade Journal.

Sir,—We are of the same opinion as Mr. Wesley Lambert, whose letter appeared in your last week's issue, viz., that Mr. Glynne Williams' bell may not be a genuine sixteenth-century antique. Colour is lent to this suspicion by the spelling of the name, E. H-MONY. As far as we have been able to trace, the Hémonys were seventeenth-century founders, and we cannot find mention of any Hémonys who were casting bells in the sixteenth century.—Yours, etc.,

John Taylor & Company.

Bell Founders and Bell Hangers,
Bell Foundry, Loughborough.
August 5, 1933.

Meehanite Metal.

The International Meehanite Metal Company, Limited, of 14-16, Church Street, London, N.1, has now been completely organised and Mr. E. M. Currie, late of Messrs. Alfred Herbert, Limited, of Coventry, has been engaged as technical manager. Mr. Currie has been in charge of the Coventry Foundries of the firm mentioned for a number of years and is an acknowledged authority. Mr. Reece, chief assistant to Mr. Smalley of the Meehanite Metal Corporation of U.S.A., arrives in London shortly and will remain with this company for several months in order to assist licensees.

A licence has recently been completed with Messrs. Ashmore, Benson, Pease & Company, Limited, who will consequently become the first important licensee of this company. The International Meehanite Metal Company, Limited, covers all countries outside the U.S.A. The British Patent Nos., under which this company issues licences in this country are as follow:—210,118, 292,164, 312,126 and 337,844.

The extensive development of Meehanite in U.S.A. has been based on the establishment of 14 grades of Meehanite, each having separate and distinctive properties and meeting every need of engineering requirements, including the following:—(1) Acid resisting, (2) abrasion resisting, (3) erosion resisting, (4) heat resisting and (5) exceptional strength and toughness.

Each grade of Meehanite is controlled to meet specific service requirements, and the new company will establish the manufacture of each of these in the foundry to whom it grants a licence, complete metallurgical and foundry service being rendered.

Exchange of information between the Meehanite Metal Corporation of America and the International Meehanite Metal Company, Limited, has been arranged, and the licensed foundries in Great Britain will receive the information which is issued from time to time to the American licensees by the Meehanite Institute, of which Mr. Smalley is President. The researches of the Meehanite Institute during the past few years have led to important developments in foundry practice amongst the Meehanite licensees in U.S.A.

Radiographic Tests.—In "Chemical & Metallurgical Engineering," H. R. Isenburger deals with the radiographic examination of metallurgical products by means of X and gamma rays, and shows that the depth of defects, etc., may be determined by making double exposures on the same film and by moving the test object. In discussing the costs of radiography, the author shows that a marked economy may be realised by using sensitised paper instead of a double-sided film.

Electric Furnaces in Russia.

In a Paper contributed to the recent Montreal meeting of the Electrochemical Society, Mr. C. H. Vom Baur indicated that Russia is going to employ electric furnaces extensively. He reported that there will be available for operation in 1934 a total of 449 furnaces and that 256 of the Héroult type, devoted to steel manufacture, will have an annual capacity of 1,600,000 tons, representing about 15 per cent. of the total steel output of Russia.

It appears that in the five years ended with 1932 some 205 electric furnaces were built, that 95 are in process of construction this year and that since 1914, 149 furnaces were imported. Of the total of 449 to be in operation in 1934, furnaces of the Héroult design include 86 of 4 tons capacity, 49 of 6 tons, 26 of 10 tons and one 15 tons and one about twice that size, these last two being among the furnaces scheduled for building this year. About 84 per cent. of the furnaces are of the arc type, including Detroit furnaces, but there are induction furnaces of the Ajax-Watt type and some high-frequency and resistance aluminium-melting furnaces. The largest size Héroult, already mentioned, is an oval, "with a perfect ellipse and a perfect isotherm, its six 12-in. dia. graphite electrodes being so placed as to conform to these two features.

At present the Soviets are not making enough electrodes to supply the home demand. Two plants are building to make graphite electrodes. These are designed for 2,600 tons a year. Good Russian practice to-day, says Mr. Vom Baur, with the best graphite electrodes averages about 6 kgs. (13.2 lbs.) per ton of steel made. In 1934 their demand for this specialty would be 9,680 tons. Unless additional plants are built they would still need 7,000 tons, not to mention the graphite electrodes for the Detroit type, say an additional 500 tons.

Three Miguet furnaces have been imported from France. They are at Dnieperstroy, two for ferro-manganese and one for barium aluminate. Each is single phase, 11,000 k.v.a., stepping down from 36,750 volts to a variable between 25 and 55 volts with 56 voltage steps, made under load. The switching arrangement and transformers are most elaborate and costly. The Miguet electrode is 4 m. (over 13 ft.) in dia. The outside is an annular ring, made out of close-fitting dovetailed carbon blocks and the inside tamped carbon much the same as in a Soderberg.—"The Iron Age."

Scottish Steel Trade Co-ordination.

The £12,000,000 scheme for the reorganisation of the Scottish steel industry has been under consideration of the Tariff Commission and the directors of the various companies concerned. The principal firms affected by the proposal are Messrs. David Colville & Sons, Limited, Messrs. William Beardmore & Company, Limited, the Steel Company of Scotland, Limited, and Messrs. Stewarts and Lloyds, Limited. It is suggested that the various works of these concerns at Mossend, Parkhead, Motherwell, Cambusland, Glengarnock, Loch Earn, Newton and Hallside, and Blochairn should be co-ordinated to engage in specialised production at each plant. The scheme suggested will eliminate competition and overlapping, and recommends that each steelworks should be organised for the production of special material. The Tariff Commission, who imposed tariffs on foreign steel a year ago, made it a condition of protection that the home industry would be reorganised. A number of meetings have been held in Glasgow, at which the subject has been discussed, and a report has now been submitted to the Tariffs Commission, of which Sir George May is chairman.

Random Shots.

We all know the type of man who is "agin' the government." He invariably finds the fly in every ointment; he never does anything much himself, but he can explain in detail the mistakes made by those who do the work. The following instructions, which are directed, sardonically enough, at "The Perfect Member," come from A. C. O. in "The Record," and can be read with edification by most members of commercial and other organisations.

* * *

1. Don't come to the meetings.
2. If you do, come late.
3. If the weather doesn't suit you, don't think of coming.
4. If you do attend a meeting, find fault with the work of the officers and other members.
5. Never accept an office, as it is easier to criticise than to do things.
6. Nevertheless, take offence if you are not appointed on a committee, but if you are, do not attend committee meetings.
7. If asked by the chairman to give your opinion regarding some important matter, tell him you have nothing to say. After the meeting tell everyone how things ought to be done.
8. Do nothing more than is absolutely necessary, but when other members roll up their sleeves and willingly, unselfishly, use their ability to help matters along, howl that the organisation is being run by a clique.
9. Hold back your subscriptions as long as possible, or don't pay at all.
10. Don't bother about new members; let the Secretary do it.
11. When a dinner is given, tell everybody money is being wasted on blow-outs which make a big noise and accomplish nothing.
12. When no dinners are given say the organisation is dead.
13. Don't ask for a ticket for the dinner until all are sold.
14. Then swear you've been cheated out of yours.
15. If you do get a ticket don't pay for it.
16. If asked to sit at the top table, modestly refuse.
17. If you are not asked, kick up a row.
18. Don't tell the organisation how it can help you; expect it to know everything.
19. When you attend a meeting, vote to do something and then go home and do the opposite.
20. Agree with everything said at the meeting and disagree with it outside.
21. Get all the organisation gives you, but don't give it anything.

* * *

An old farmer was being told of all the scientific marvels of the age—of the submarine, the aeroplane, wireless, etc.

"Well," he said, "I can kind o' understand them things, but what gets me proper is 'ow they get a marble into a lemonade bottle."

* * *

Foreman (on excavation job): "Do you think you are fit for really hard labour?"

Applicant: "Well, some of the best judges in England have thought so."

* * *

A brass band once visited a small village and the people were delighted with it, but they couldn't make head or tail of the trombone, so they sent for old Giles Hoskins, who claimed he understood music.

Old Giles watched the performance of the trombone player for some time. Then he said, with a sneer:

"Don't 'e take no notice of him. There's a trick in it; he don't swallow it every time."

* * *

Teacher: What was Oliver Cromwell famous for?

Johnny: His memory.

Teacher: His memory?

Johnny: Yes; they erected a monument to it.

Marksman.

Time Studies in Foundry Work.*

By V. Bernard (Technical Manager of the Rosières Foundries).

[French Exchange Paper.]

Three Examples of Determining the Time Necessary for Executing Work.

Whatever system of payment is adopted for a given manual operation, as exact a knowledge as possible of the time necessary for its execution is the indispensable basis for its remuneration.

It is sound doctrine that such determination should be preceded by a rational organisation of the work to be remunerated. But rational organisation or, more precisely, the best organisation that can be devised in the given circumstances cannot always be carried out immediately it is thought of, and still less immediately the desirability of altering a defective method of working has been recognised, whereas payment for the work done must be made without delay. It is, in fact, a daily necessity. Consequently a timing system must generally be applied to operations which it would be impossible to submit as models of organisation. It is certainly in such circumstances that timing is most frequently employed, and under these conditions it in any case meets an obvious need.

There can obviously be no question of measuring the duration of a working operation which is imperfectly defined or is executed irregularly from one moment to another, but as soon as the method of working is definitely determined, whether this be excellent, mediocre or even bad, timing can be introduced.

While, as M. Nusbaumer[1] observes, scientific organisation has frequently been reduced to a mere question of timing, thus erroneously regarding a part as the whole, conversely it would be a grievous error not to accord to timing a value of its own apart from any scheme of scientific organisation, since it is the only method of accurately determining the relation between work and its remuneration.

It is not unnecessary, perhaps, to emphasise this point. When one ventures into the abundant literature devoted to the scientific organisation of labour, one is often tempted to recoil before the length and hardness of the path suggested by orthodox writers for reaching the promised land.

We may cite the classical example of shovelling. For the proper organisation of shovel work so as to obtain the best output it is necessary to determine the best form for the shovel, the most suitable capacity, the section and dimensions of the handle, the distance to which the material ought to be thrown, etc., and to extend this study to each kind of material to be handled: ores, fuels of different kinds, moulding sand, scrap, etc. This having been done and suitable tools having been provided, all that is necessary is to time a gang very carefully and to deduce from this last operation the normal times required for the execution of the work. After a period of training during which the men become accustomed to the new method of working, we at length reach the stage of standardised

Fig. 1.—The Castings included in the Time Study Experiments.

Fig. 2.—Special Arrangements are made for Stripping certain Sizes.

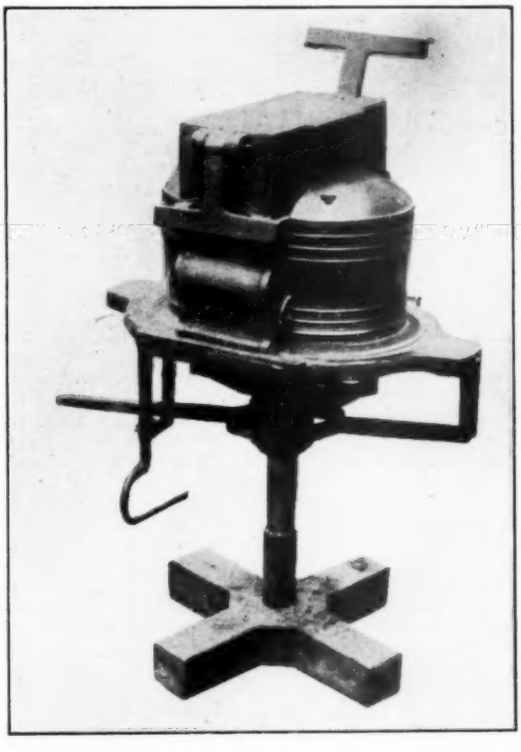

Fig. 3.—Shows how the Feet have been Withdrawn.

* A Paper presented at the Cardiff Conference of the Institute of British Foundrymen.

1 "L'organisation Scientifique des Usines" (Paris 1924: Nouvelle Librairie Nationale).

shovel work and we possess an unquestionable basis for the payment of the work.

As shovel work, however, is not an industry, and as in any works of average size there are thousands of similar operations, it is fairly clear that it is impossible—although it is desirable—to subordinate in principle all determination of the times of execution to the perfect organisation of the work beforehand.

At the Rosières Foundries, which manufacture domestic enamelled heating appliances and cooking ranges, laundry equipment and cast-iron hardware, builders' and miscellaneous castings, the necessity of establishing a timing office has been recognised, its activities—quite apart from any Taylorisation programme—being solely devoted to the determination of the various times. All the moulding operations, stripping, fettling, drilling, enamelling and fitting, and all hand operations capable of precise delimitation, etc., are paid as piecework on a time basis calculated as carefully as possible, and the number of operations paid for on this system is in the neighbourhood of a hundred thousand.

The functions of the timing office comprise:—The determination of the normal times relating to the operations performed in the manufacture of new articles (for example a new heating apparatus to be placed on the market); the revision of times previously allowed, when any modification is introduced in a process of manufacture; the permanent supervision of wages for the purpose of discovering errors that may have

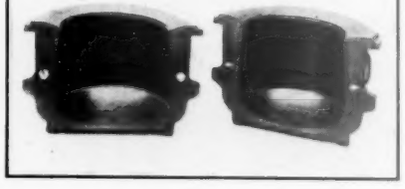

Fig. 4.—Cast-Iron Core Boxes are used.

been made in either direction in the allocation of times, and the correction of such errors on the basis of further investigation.

It was originally assumed at Rosières that after it had been applied a piecework price could not be modified on any pretext whatsoever, provided the conditions affecting the execution of the work in question had not altered.

This was rather too elementary a conception of fairness. A piecework price is the product of two factors: the time of execution and the wage per minute by which it is multiplied. Of these two terms the second alone, which represents at least a tacit agreement, cannot be varied without the mutual consent of the parties; the first term, on the other hand, represents a fact and, in short, measures a phenomenon, and it would be impossible for it to retain a false value continuously if it were found that its initial determination was vitiated by errors.

There is, however, no lack of causes of error: the most frequent arises from the workman or the gang of men timed, either because the workman or the gang do not possess sufficient training and will not acquire it until later owing to the work being new to them, or else because they have more or less slacked in the hope of obtaining a more advantageous piecework price.

The author is aware what the reply to him will be here, viz., that an insufficiently trained or dishonest workman ought not to be timed. He would reply, however, that the fixing of the wage cannot be subordinated to the realisation of conditions which are absent when the work is carried out, and that workers possessing both the requisite skill and unshakable conscientiousness, or merely unlimited confidence in their employer's methods, are not necessarily always available.

If we confine ourselves to these two factors alone it will be seen that the observations carried out even by an experienced time recorder endowed with the critical faculty may result in excessive values and cause longer times to be allowed than those which would be necessary in the case of a trained operator working at a reasonable speed. Conversely, it may happen in the case of an exceptional workman that the times observed are too short for the average of the others. Hence the necessity of regarding the results obtained merely as a provisional expression of the truth, subject to revision, and, since a price based upon inadequate times could not be maintained in force, the necessity of regarding the correction of times and prices found to be too high is legitimate. Naturally, such corrections must not be made arbitrarily, but must be deduced from fresh chronometric analyses of the work.

At the Rosières Foundries, where the timing office has been in operation on these principles for several years, the abandonment of the narrow dogma of the fixity of the times allowed (and the prices derived therefrom) has not given rise to any labour difficulties. Probably this is due to the staff having recognised that the management was just as ready—and generally spontaneously—to increase a price found to be too low, as to reduce another which was estimated too high, and that in short it was clearly anxious to equalise wages for equivalent pieces of work.

Examples from Practice.

By way of example, a summary of three timing studies relating to different types of work is here given. These comprise: A study relating to an *individual* piece of hand-moulding work ("gipsy pots"); a study relating to *collective* machine-moulding work, and a study relating to hand haulage on rail tracks, which facilitated the determination of the coefficients applicable to the calculation of the times necessary for all the haulage carried out in the works.

Time Study in Moulding "Gipsy Pots" (Individual Work).

The article to be moulded is shown in Fig. 1. It is made in 22 different dimensions corresponding to capacities varying from 2 to 120 litres, which are respectively described as Nos. 4, 6, 8, 10, 12, 14, 16, 18, 21, 24, 27, 30, 36, 42, 48, 55, 60, 70, 80, 90, 110 and 120.

The moulding plant is sufficient for the number of articles of each size to be manufactured annually. It consists of an ordinary metal pattern for each of the last twelve numbers of the series (No. 27 and over), the sale of which is not very brisk. For each of the first ten numbers (Nos. 4 to 24), of which a large number are made, the pattern comprises special devices enabling the box to be easily adjusted in relation to the pattern and to facilitate stripping, or even to make this possible where there are undercut parts (feet) (Figs. 2 and 3). It is completed by a cast-iron core-box (Fig. 4) and a set of boxes (Fig. 5). Among these first ten numbers it may be well to note the three smallest (Nos. 4 to 8), which are moulded on apparatus enabling two castings per box to be obtained.

The object of the time study undertaken was the readjustment of certain very old moulding prices which had been arbitrarily rectified several times and were always disputed by the parties interested. It was therefore decided to carry out methodical determinations of the necessary times in order that the prices should at length be established on a sound basis.

The example here summarised refers exclusively to pots Nos. 10 to 24, *i.e.*, to seven different articles moulded in the same manner.

The work of the time-recorder consisted in first of all examining in detail the conditions under which the operator worked, that is, in making an inventory of the material and equipment placed at his disposal and in seeing that they were in good condition. These particulars were recorded, with a sketch showing the lay-out of the shop (Fig. 6) on the same sheet which was afterwards to show the time records; for it is obvious that these particulars would have been deprived of value if they had not been accompanied by all the details descriptive of the method of working to which they related.

The recorder then carried out an analysis of the work for the purpose of determining the elementary operations constituting the natural divisions of the whole operation, the duration of which it was desired to know and which were the subject of separate measurements. In the case under examination it was found that the moulding of one pot comprised 54 distinct elementary operations, 45 of which are repeated each time a mould is prepared, while the other 9 are executed only intermittently (preparation of sand, casting, stripping, etc.).

A steady workman quite familiar with this work having been chosen, the record of the times was then made and repeated over a series of 20 castings. One of the timing sheets is reproduced below, the measurements being expressed in hundredths of a minute. -

DATE: 7.12.28.
WORKMAN: AUBRUN
OPERATION:— HYDRAULIC MACHINE MOULDING OF STOVE TOPS. 2 MOULDING BOXES, 1 CASTING PER BOX MOULDING OF TOP PART.
OBSERVER: BOURJON

N°	OPERATIONS REPEATED ON EACH CASTING	1	2	3	4	5	17	18	19	20	AVERAGE TIMES
1	CLEANING THE SURFACE, APPLYING BLACKING.	38	42	33	30	32	32	35	42	38	34 2
2	PLACING THE MOULDING BOXES ON THE FRAME	24	35	29	34	27	25	36	28	27	25 8
3	PUTTING IN NEW SAND AND SIEVED SAND	35	36	32	32	35	34	31	32	32	34 5
4	PUTTING IN SAND	37	58	38	38	42	37	39	36	43	41 2
5	HAND RAMMING	41	58	42	41	45	37	38	39	41	39 3
6	PUTTING IN SAND	26	25	26	27	25	27	24	22	23	25 3
7	LEVELLING AND BRINGING FORWARD THE PLATE	16	16	18	14	15	18	18	18	20	17 0
8	RAMMING & LEVELLING	33	30	30	30	28	27	28	30	29	29 2
9	REMOVING THE MOULD.	17	15	13	15	14	11	14	13	12	13 0
											299 5

N°	INTERMITTENT OPERATIONS			TOTAL TIME	NUMBER OF CASTINGS	TIME PER CASTING
1	SCREENING SAND	572 × 2 =		1144	12	95 4
2	SIEVING FRESH SAND	525 × 2 =		1050	25	42 0
3	CASTING	260 × 4 =		1040	8	130 0
4	STRIPPING	1787 × 2 =		3574	12	297 8
5	MOISTENING & PREPARING SAND	1230 × 2 =		2460	10	246 0
	TIME OBSERVED: 2 595 × 4 · 10 38 + 8 11 / 18 49					811 2
	SPEED: 105 %					
	NORMAL TIME: 18 49 × 1 05 = 19 41 4					
	TOLERANCE: REST 10% WASTE 10%					
	TIME ALLOWED: 19 41 × 1.2 = 23 29					

Plant.—(*a*) 2 hydraulic moulding machines; (*b*) 2 pattern plates; (*c*) 50 No. 2 moulding boxes; (*d*) 2 stumps; (*e*) 2 frames (undersand); (*f*) 2 hoists mounted on monorail; (*g*) 4 clamps for No. 2 boxes; (*h*) 2 wheelbarrows, and (*i*) 2 assembling dowels.

Tools.—4 steel shovels, 2 hammers, 2 screens, 1 sieve, 2 spatulas, 2 bellows, 2 blacking bags, 1 smoother, 2 brushes, 1 vent wire, 1 rake, 2 sprayers and 4 hand-ladles.

Working Conditions.—The two machines are served by a gang of 6 men, consisting of two moulders, two assemblers and two strippers, who have at their disposal the plant and utensils enumerated above. One of the moulders moulds the top and the other the bottom part. The two assemblers help the moulders in handling the moulding boxes. They cut the runners, place the cores if there be such, close the mould and fix the clamps, and one of them takes the mould to the casting floor by means of a pulley. The two strippers strip the castings and arrange them in place, carry away the boxes, place the sand near the machines and screen the quantity required.

Casting is done by the two moulders and two assemblers. The metal and fresh sand is supplied by labourers, who also remove the castings. The arrangement of the shop is shown in the sketch attached to the file (shop, 2nd group).

The time study having been thus carried out on 5 of the 7 pots constituting the series corresponding to one and the same method of operation, it was found that the times necessary for executing the other two could be determined by interpolation with sufficient accuracy, so that

some 1,800 measurements could be dispensed with.

To pass from the gross timings thus determined or estimated to the times to be allowed as a basis for calculating the prices, it was still necessary to define the necessary corrections:—(1) In order to convert the speed of the workman observed to the normal speed of the average worker; (2) in order to take account of the time inevitably lost and the necessity for resting in the course of the day; (3) in order to take into consideration castings spoiled, owing to unknown and absolutely unavoidable causes, for which the moulder receives no payment. In the present study no correction for speed has been made, as the workman timed has been regarded as representing the type of the normal operator.

The correction for lost time, which the author terms "rest" tolerance and is fixed generally at 10 per cent. of the gross time, was made the subject of experimental verification in the course of this study: during 8 days the observer confined himself to recording the "no-work" times for several workmen (going for a drink, rolling a cigarette, resting, taking a "breather" at the door of the shop, waiting for the liquid metal, W.C., etc.). He found that over a total of 64 observations, the average time lost each day per workman amounted to about 40 mins. in 8 hrs., which confirmed the accuracy of the correction adopted. To sum up, the gross times were increased by 15 per cent., and the prices established on this basis, which have been in force for four years, have not given rise to any trouble.

Timing Study in Moulding Flat Castings on Hydraulic Machines (Executed Collectively by Gangs of Six Men).

This, like the preceding study, was prompted by the necessity of revising old prices that had been fixed at different times and were lacking in uniformity. A considerable number of men working in gangs of six were concerned in the particular work to be paid for. Each gang had the requisite hydraulic machines, joint-boards and moulding boxes, and manufactured flat castings for kitchen ranges, executing the moulding, casting, stripping and preparation of the sand (Figs. 8, 9 and 10).

A clear idea of the time-recorder's working method will be obtained from a perusal of the following introductory note, which is an extract from the file containing the results of this study:—

Conditions of Work.—The work of each of the groups in the machine-moulding shops is carried out by a gang of six men, consisting of two moulders, two assemblers and two strippers. Each gang has two hydraulic-moulding machines, three sets of moulding boxes of different dimensions (see illustration of moulding boxes, **Fig. 11**) with their accessories ("frames," assembly dowels, clamps, etc.) and the necessary tool equipment as enumerated on the timing-sheets.

As regards the moulds made in boxes Nos. 1 and 7 (third group of machines), 0, 4, and 10 (sixth group), and 1, 5 and 12 (fifth group), the operation of the moulding boxes and the assembling are carried out entirely by hand.

The assembling of those made in boxes Nos. 2, 6 and 9 (second group) is done by hand on a stump, and the moulds are carried to the casting floor by means of a pulley and monorail.

In the case of the moulds made in boxes Nos. 3, 8 and 11 (fourth group), the gang has a hoist for each machine for removing the parts of the moulds from the machine which has rammed them and for assembling them on the assembly bench; they are afterwards transported to the casting floor by means of two other hoists and a system of monorails.

The pattern plates are taken from the store to the shop by men with whom this study is not concerned. They are placed in racks, the position of which is shown in the accompanying diagrams. The moulders take the plates in the order, indicated by their working ticket, and place them on the machines; one moulds the top and the other the bottom part. One of the assemblers helps them to place the boxes over the patterns and to remove the parts moulded when this is done by hand.

Besides helping the moulders in this way the assemblers are required to cut the runners, retouch the moulds, place any cores, if there be such, assemble and put the moulds in place on the casting floor which they have previously levelled. When the metal has been brought, the casting is done by the two moulders and the two assemblers.

The strippers strip the castings and arrange them close to the track serving the shop. They carry the moulding boxes up to the machines at the point shown in the plans. They damp the sand, after stripping, and screen it in the moulding shop. The ground on which they work is always distinct from the assembling and the casting floor, since each group of machines has two positions, which are used alternatively.

Timing.—The time records applied, for each of the twelve numbers of moulding boxes, to several different patterns, and in their selection the various degrees of difficulty liable to be encountered were an important factor, in order that a series of measurements from which a valid mean might be obtained should be available for each moulding box.

The patterns requiring special moulding operations (placing cores and core irons, etc.) were timed separately, but only in so far as the duration of these operations exceeded the differences in time observed in relation to the average when the patterns were moulded without cores or core irons.

The time measurements recorded on the time-sheets relate to two categories of operations: (1) Work of the moulders and assemblers and (2) work of the strippers and casting. As regards the first category, the work of observation applied to one of the two moulders, and the times obtained were multiplied by four, as four men co-operated in executing the work. This assumes that the four functions are exactly equal. This is the case as regards the two moulders, each of whom has to carry out the same operations on his machine. On the other hand, the work of the assemblers is usually more or less different from that of the moulders; when it was greater the difference has been noted under the heading "Wait for the assembler."

As regards the second category, the record applies to the moulders and the assemblers for the casting which they execute, and to one of the two strippers for the other work. The observed times were multiplied by four and two respectively in order to obtain the total time necessary.

In the work of the strippers, the operation of "stripping" entered on the time-study sheet includes the following elementary operations which are not distinguished in the time measurement: (*a*) Breaking and removing the runners, (*b*) removing the clamps connecting the two parts of each moulding box, (*c*) stripping the top part, (*d*) removing the castings from the sand and arranging them in place, (*e*) stripping the bottom part and (*f*) carrying the boxes up to the machines at the points indicated in the plans of the shops.

The total time necessary in carrying out the moulding-box work is obtained from the sum of the working times of the moulders and assemblers (the moulding proper and casting) and the working times of the strippers.

In addition the times allowed comprise an increase of 10 per cent. for rest, an increase of 10 per cent. for waste, and a correction, dependent upon the speed of the workmen observed, which is indicated in each particular case on the timing sheets.

By way of complementary information an illustration of the moulding boxes used and another showing the plan of the shop are reproduced, together with a timing sheet extracted from the timing records.

DATE: 3rd OCT. 1928. FROM 7.50 A.M. TO 12.5 P.M. AND FROM 1.30 TO 5 P.M. OBSERVER: BOURJON
WORKMAN. GIMONET.
OPERATION:- MOULDING GYPSY POT N° 16 ON MARBLE (1 CASTING PER FLASK.)

N°	OPERATIONS REPEATED ON EACH CASTING.	1	2	3	4	5	17	18	19	20	AVERAGE TIMES
1	PLACING CORE BOX ON TABLE	15	15	18	20	18	24	22	13	22	19 1
2	FIXING FRAME ON CORE BOX	18	21	21	18	18	22	30	23	21	21 6
3	PUTTING SAND IN CORE BOX	36	35	36	38	39	40	44	45	44	38 4
4	RAMMING SAND	30	22	26	24	25	27	30	27	25	26 9
5	PUTTING IN SAND	15	19	19	17	23	25	24	21	21	22 5
6	RAMMING	29	30	28	28	31	31	33	30	33	30
7	PUTTING IN SAND	16	18	22	22	18	19	19	20	18	18
8	RAMMING.	16	13	18	14	15	14	16	16	15	14 7
9	SMOOTHING LEVEL WITH MOULDING BOX	8	48	8	7	7	8	8	7	7	7 2
10	VENTING	18	15	14	15	19	18	19	18	18	16 8
11	TURNING OVER THE JOB	19	30	23	30	22	23	22	23	22	22 5
12	UNDOING & RAPPING THE CORE BOX	8	8	6	7	8	8	8	8	9	7 4
13	WITHDRAWING THE CORE	32	32	36	40	33	36	41	36	36	36 9
14	SPRAYING WATER ON CORE	7	6	6	8	7	7	8	7	5	7 1
15	DUSTING THE CORE	11	9	9	9	8	10	11	9	7	8 4
16	REPAIRING & SMOOTHING THE CORE	80	82	92	82	81	92	88	122	96	89
17	CLEANING WITH BELLOWS	6	7	8	9	11	10	11	12	12	10 8
18	CARRYING THE CORE TO THE CASTING BED.	26	26	26	25	22	22	25	28	28	26 9
19	PLACING ONE PART OF MOULDING BOX ON MACHINE	12	19	13	11	14	19	18	22	19	16 1
20	CLAMPING THE TWO PARTS OF MOULDING BOX	15	10	10	11	13	14	12	11	10	12 2
21	DUSTING THE PATTERN	9	10	9	9	10	10	10	10	11	9 3
22	PUTTING SAND IN MOULDING BOX	18	19	13	14	14	14	19	18	17	15 9
23	PEG RAMMING BOTTOM OF PATTERN	49	49	55	52	54	57	60	57	56	54 7
24	PUTTING IN FRESH LAYER OF SAND	10	9	10	11	11	12	14	15	16	11 4
25	PEG RAMMING	49	46	47	42	45	42	43	41	43	44 3
26	DISCONNECTING AND COVERING RUNNER WITH NEW SAND.	18	20	22	20	22	25	28	25	25	23 2
27	PLACING A LAYER OF SAND	18	19	20	18	24	23	26	28	23	21 7
28	PEG RAMMING	94	94	102	100	101	108	105	108	99	100 8

N°	OPERATIONS REPEATED ON EACH CASTING	1	2	3	4	5	17	18	19	20	AVERAGE TIMES
29	PLACING A LAYER OF SAND	20	22	25	25	26	21	25	24	24	22 4
30	FLAT RAMMING	19	18	19	18	19	21	20	19	20	19 2
31	SMOOTHING LEVEL WITH MOULDING BOX	7	6	6	7	7	9	6	7	7	6 6
32	VENTING	48	8	8	10	10	10	8	9	8	8 6
33	DEPRESSING LEVER TO RELEASE PATTERN	28	20	21	21	19	25	27	25	21	22 6
34	UNCLAMPING THE TWO PARTS OF BOX	7	9	11	13	12	10	12	11	11	10
35	LIGHTLY RAPPING ONE PART	7	5	5	6	5	4	4	5	5	4 7
36	REMOVING TOP PART	—	33	36	34	36	40	45	30	42	37 9
37	LIGHTLY RAPPING THE BOTTOM PART	7	6	6	6	6	5	5	5	6	5 6
38	REMOVING MIDDLE PART	10	10	18	15	9	11	9	10	10	10 6
39	RAISING THE LEVER, CLEANING PATTERN	25	28	44	30	28	32	35	51	32	31 8
40	SPRAYING TOP PARTS WITH WATER	12	15	15	9	11	16	10	8	13	11 2
41	MAKING & SMOOTHING RUNNER	89	75	90	66	62	89	77	66	71	75
42	CLEANING TOP PARTS WITH BELLOWS	43	55	46	39	40	49	50	52	49	45 4
43	PLACING ONE TOP PART ON CORES	70	60	50	61	52	53	46	49	55	53
44	PLACING ONE PART OF BOX ON MACHINE	16	18	19	20	20	19	22	22	16	10 6
45	PUTTING MIDDLE PART IN PLACE & CLAMPING	55	55	65	55	56	66	53	45	57	51
46	DAMPING THE INSIDE OF A BOX	16	12	11	13	12	12	13	10	10	11 8

N°	INTERMITTENT OPERATIONS.	1	2	3	4	5	17	TOTAL TIME	NUMBER OF CASTINGS	TIME PER CASTING
1	SIFTING SAND WITH SCREEN (10 mm MESH)	33 1						22 1	25	68 4
2	SIFTING SAND WITH FINE SIEVE (4 mm MESH)	16 3	6 0	2 0	3 45			16 15	25	60 6
3	SIFTING NEW SAND WITH FINE SIEVE	5 35						5 35	25	15 8
4	SUNDRY OPERATIONS (PREPARING TOOLS, HEATING COKE BOX, OBTAINING BLACKING WATER ETC.	80	75	21	55	80		10 56	25	42 2
5	CLEANING UP SHOP	68	2 7	92	134			5 36	25	21 4
6	CASTING	2 7	60	5	24	8		15 72	25	54 6
7	STRIPPING	36	35	73	29	174		37 16	25	150 9
8	MOISTENING SAND AND TURNING (OVER WITH SHOVEL	22	70	5	46	2 35		31 52	25	70
9	FETTLING WITH FILE	13						13	13	1
	TOLERANCES (SPEED 100% / WASTE 5% / REST 10%)									6 081

TIME ALLOWED 17 88 × 115 - 20 56
TIMES OBSERVED 17 88 0

Plant.—1 moulding bench, 1 moulding machine, "Anglaise 16" type (weight 210 kg) 1 core box in two parts (weight 43.8 kg.), 22 moulding boxes in three parts (weight 38.1 kg.), 22 wooden bottoms, sand, pulverised wood charcoal, and parting powder.

Tools.—1 shovel, 1 hammer, 1 mallet, 1 flat rammer, 2 peg rammers, 1 straight-edge, 1 spatula, 2 smoothers, 2 venting wires, 1 bellows, 1 feather duster, 1 skimmer, 1 casting ladle, 1 file, 1 chisel, 1 stove, 1 blacking bag, 1 dust box, 1 atomiser, 1 screen, 1 sieve.

Working Conditions.—The moulder works at place No. 11 in shop 23. The arrangement of the plant is as shown in the sketch (Fig. 6), the tools being arranged to the best advantage on the bench and within a radius of 1 metre above it. The moulder carries out the operations enumerated above in the order shown by the record of times for the operations repeated for each casting; the intermittent operations are carried out in due course.

The fresh sand, metal and water are distributed by the labourers. The water supply is 15 metres from the working position.

Observations.—The operating lever of the machine is too long; it hampers the moulder's movements and may injure his legs when he turns the patterns.

This study as a whole was concerned with about forty different pattern-plates and necessitated some 10,000 measurements of elementary times. The work occupied two months, but as a result the staff was provided with a system by

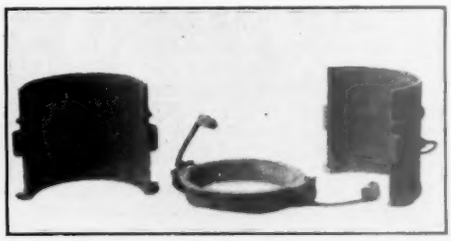

Fig. 5.—Type of Moulding Box used.

which the work has been regulated for more than four years.

Before the application of the piece-work prices based upon this study it had also been applied tentatively for a month to all the workmen concerned, who were already working by the piece at the old rates. This precaution is always useful, as in certain cases it enabled us to discover errors and rectify them before publication of the prices. In the present instance, however, it was unnecessary to make any modifications in the times allowed.

Time Study on Hand Haulage over Narrow-Gauge Tracks.

Until this study was undertaken the determination of haulage times was effected in each particular case, and it was impossible to use with certainty the observations relating to one transport operation for the purpose of calculating the time necessary for the same work carried out on another route or track. The frequent changes of route owing to the numerous alterations in the yards and shops occasioned by the development of the works caused the timings and prices to be continually questioned, and the

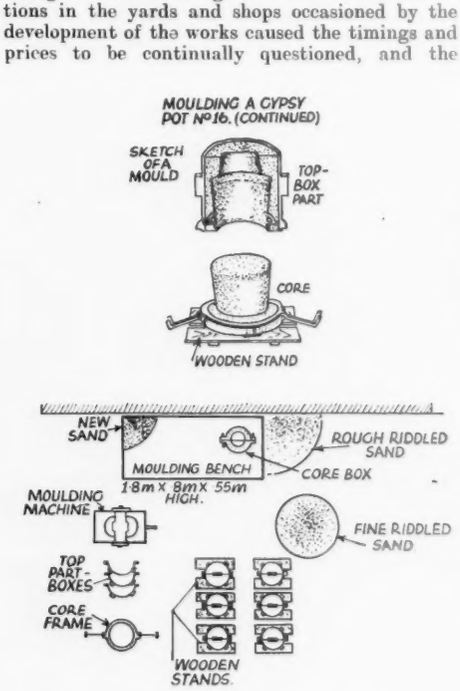

Fig. 6.—Sketch of Lay-out of Working Conditions.

large amount of work demanded by the requisite revisions was very troublesome. It was therefore decided to determine coefficients which could be employed in every case, so that the fixing of the time necessary for any transport operation might be reduced to a simple calculation.

The operations subjected to examination comprised loading, hauling the load over a given distance, unloading, and returning empty to the starting point by the same route. The operations applied to many different kinds of articles:

Fig. 7.—Lay-out of the Working-Places detailed in the Sketch Fig. 6.

supplies for the foundry, the transport of castings in the shops, or finished goods to the store, the removal of scrap, etc. Various types of trucks were used, and these will be described later. The trucks are pushed by two men, this being the most convenient number. Two men are, in fact, necessary for certain handling operations in loading and unloading and are generally sufficient. They can push the truck to the best advantage without incommoding each other, which is not the case with three men. This study is concerned only with the determination of the haulage times. The times necessary for loading and unloading have been reserved for a further study which is not here reported. The report of the time-study office is here reproduced in full:—

Factors Affecting the Haulage Time.—Apart from the activity and muscular power of the gang, which by the selection made are assumed to be constant and to correspond to a normal average, it is necessary to take into account the factors relating to the track and the rolling-stock.

Track.—In principle the following elements play a part: the section and weight per metre of the rails; the set of the permanent way (number of sleepers per rail, dimensions of sleepers, method of fixing the rail); the state of maintenance (wear of rails, longitudinal and transverse windings, connection of sections to one another or to the track appliances); characteristics and condition of such appliances themselves (turntables, crossings, switches), and finally gradients and curves.

Fig. 8.—Showing a Group of Two Machines.

(To be concluded.)

Basic-Bessemer Steelworks.

RECENT INSTALLATION IN GERMANY.

In view of the interest shown in Britain at present in the production of basic-Bessemer steel, a short description of one of the modern German works of this kind is of interest. The output of steel, about 1,500 tons per day, is produced partly according to the normal process, *i.e.*, blowing it completely in converters, and the remainder by using a duplex process, which employs preliminary blowing in converters and subsequent finishing in open-hearth furnaces.

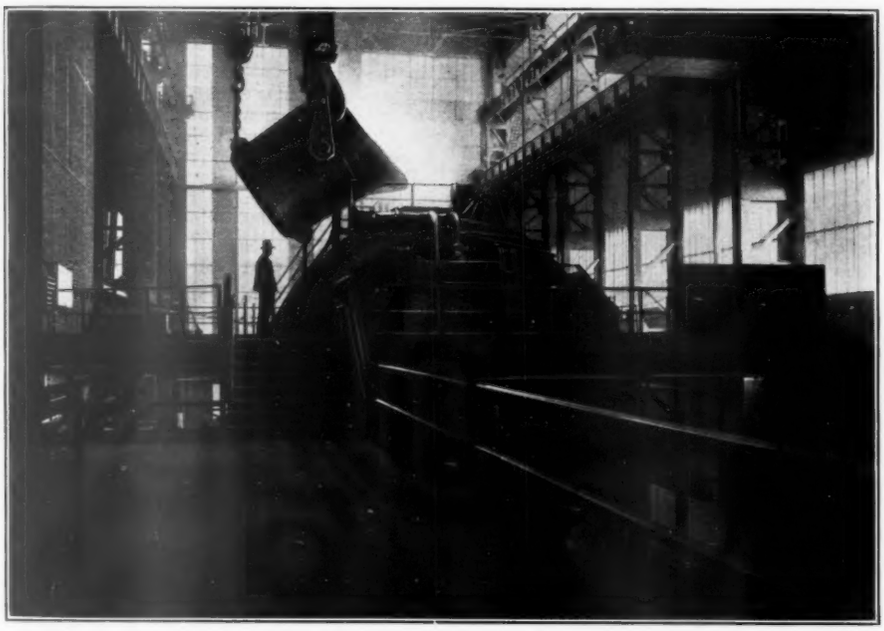

Fig. 1.—Mixer being Charged with Hot Metal from Blast Furnaces.

The main bay measures 520 ft. in length by 123 ft. in width by about 125 ft. in height. For the time being it contains one 1,000-ton cylindrical mixer and four 30-ton converters. The bay still offers accommodation for two further mixers of a similar type and two more converters of the same size. The equipment for remote control of the blowers and the measuring instruments are located between the third and fourth converter platform panels. There are three main platforms: (1) the converter platform, at a height of 23 ft. above floor level, (2) the chimney platform, at a height of 37 ft. and (3) the lime-charging platform, at a height of 73 ft. On this lime floor there are hoppers and downtakes for charging the lime and also scrap into the converters, which are standing upright under blast when these materials are charged.

The casting bay is a continuation of the mixer and converter bay. Measuring 118 ft. in length by 82 ft. in width by 98.5 ft. in height, it can be enlarged later on by a wing at right angles to it.

The Mixer.

The mixer has a capacity of 1,000 tons. It is intended chiefly to act as a hot-metal stock-holder. It also serves to give a more uniform product by mixing several casts of hot metal. The length and diameter of the mixer are almost equal so as to reduce its surface as much as possible and so keep radiation losses at a minimum. It was impracticable to adopt a purely-spherical shape, which, of course, is the nearest approach to ideal conditions, because of the cost of such a vessel and its lining.

The mixer has a length of 21 ft. and a clear internal diameter of just over 20 ft. Internally it is surface-lined with magnesite brickwork. The upper part of the mixer has a lining of refractory bricks. Between the steel plate shell and the brickwork there are two insulating layers of sterchamol bricks and granular sterchamol. The mixer is fitted with two whirling burners for coke-oven gas. A small burner above the spout of the mixer prevents undue formation of solid deposits within the spout which might be caused by cold air being vented due to the opening of the charging orifice. The mixer is mounted in two cast-steel rings attached to the shell and supported on a base equipped with roller cages. The cages are braced together, and guides are fitted to ensure that the mixer does not shift sideways on its base. The drive of the mixer comprises two electric motors with worm gear, double toothed-wheel gearing, and a rack. Either motor can perform the tilting alone, so that either of them can keep the plant working if the other one should break down. Control takes place from the mixer platform, and end switches preclude the possibility of over-tilting. The axis through the centre of gravity and the axis of rotation are displaced in respect of one another. Hence, if the current supply should suddenly fail, it is impossible for the mixer to tilt; further, in view of this emergency, a brake is also fitted. The arrangement is such that the mixer automatically rises slightly on the release of the brake, when, of course, teeming stops. In deciding on its shape, the possibility of enlarging the mixer without extensive alterations was borne in mind. By lengthening it at both ends its capacity may be raised to 1,500 tons.

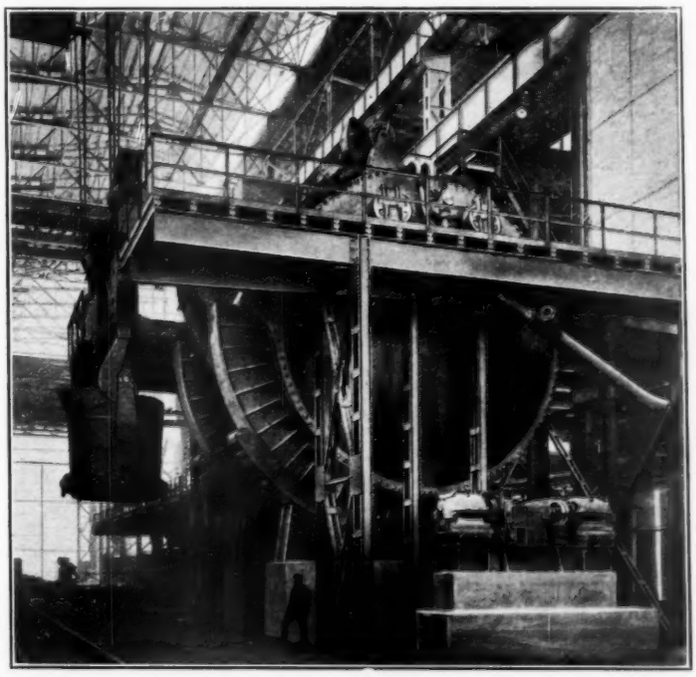

Fig. 2.—Mixer Bay showing 1,000-ton Mixer and Converter Ladle ready to Receive Hot Metal for Blowing in the Converter.

The Converters.

Each of the four converters normally works 30 tons, but they can deal occasionally with charges of 35 tons. Their diameter is about 14 ft., with a height of 26 ft. The steel shell consists of the bottom, the breast and shoulder part, and the belly with the throat. The bottom fits into a cast-steel angle ring joined by flanges to the blast box (diameter just over 7 ft.), which has a steel plate bottom. The converter is reinforced with a ring of steel plate, giving the shell greater strength in the zone where the six pairs of brackets for the supporting ring are attached. The latter consists of cast steel and had to be cast in halves on account of its size and weight. The machining of these large parts, as well as the cast-steel rings and the under-frame for the mixer calls, naturally, for machine tools of enormous size. Cast in one with the ring, the trunnions repose in the converter stand. The pillars of the stand are so far apart that the converter can be replaced by a larger one with a diameter of 14.5 ft. and holding 35 tons, if called for. On the blast-inlet side, the ring forms a chamber which the blast enters through the hollow trunnions. The blast chamber of the supporting ring communicates with the blast box by an elbow pipe. The opposite trunnion carries a toothed wheel engaging with a rack that connects up with the piston of the hydraulic-tilting gear. All the bearings receive their lubrication from a central lubricating press operated by the trunnion of the converter, so that the lubricant only reaches the bearings if the converter moves. The converters have dolomite linings, with anhydrous tar as the binder.

The control gears of the converters are

all arranged on the same sides. Thus the operator always finds the same working conditions when changing over to a different converter. The control apparatus for precision and quick tilting as well as the hand wheel of the sluice valve controlling the blast are located under a shield protecting the operator from the converter waste and the heat. The gear for precise control allows the tilting to be done extremely slowly and delicately, much to the benefit of shop management, the more so as it curtails the formation of large blocks of slag.

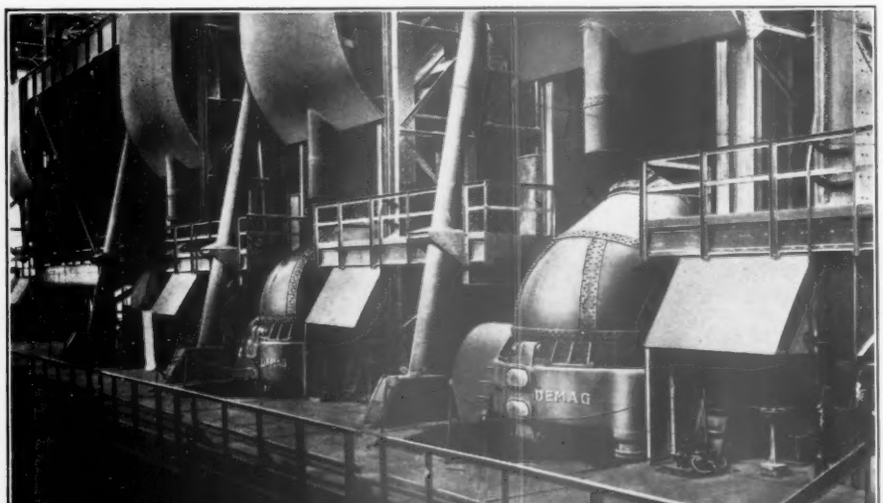

Fig. 3.—Converter Platform with Four 30-ton Converters.

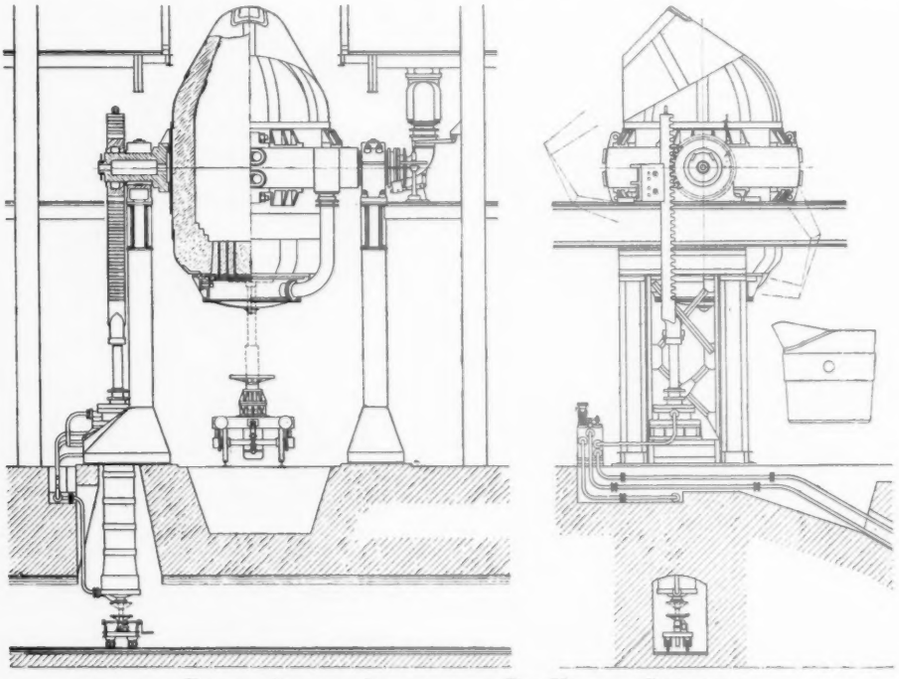

Fig. 4.—Showing Sectional and End View of Converter.

Cranes and Auxiliary Plant.

For carrying molten iron, and tending the mixer and converters, the main bay contains two 100/25-ton cranes, one 60/15-ton crane and two 10-ton cranes, all of them spanning 75 ft. 6 in. The first 100-ton crane chiefly serves to lift the 70-ton hot-metal ladles after being weighed, from the special trucks, and to tip the content into the mixer with the aid of its 25-ton auxiliary hoisting tackle, all the slag having previously been carefully removed. The same crane also does the conveying needed in the ladle lining shop. The other 100-ton crane acts a stand-by. It also carries molten iron from the mixer to the converters, after having each ladle charge weighed on the mixer scales. At the converter, the ladle contents are first cleared of slag and then discharged. A system of rods enables the weighing machine at the mixer to be operated from the mixer floor, *i.e.*, by the operator of the mixer.

When working the duplex process, the roughly-decarburised basic-steel charges are charged into ladles on ladle carriages, the full ones being pushed away. The 60-ton crane lifts the ladles and places them on special trucks for transport to the open-hearth steelworks. If normal basic (Thomas) charges, *i.e.*, fully-blown ones, are to be used for casting ingots in chill moulds, recourse may again be had to the 60-ton crane. In order to bring the ladle into position, another crane must first lift out and carry aside the part of the platform opposite the converter. The 15-ton auxiliary tackle of the 60-ton crane can also be made to co-operate with the 10-ton ingot and chill-mould crane in attendance to the casting pit.

Above the lime platform of the converter bay, working on a track 88 ft. 6 in. from the floor, there are two fast-running 10-ton cranes with special suspension tackles. They remove the lime buckets from the platform trucks that arrive on the narrow-gauge line from the lime storage, and tip their contents—5.9 cub. yds.—into the lime hoppers. The same cranes carry to the converters the other components of the charge, the coke, carbon, etc., all of which are stored in the bunkers of the lime storage, along with the dolomite and sand for the stone factory. Dolomite in lumps goes to a steel plate bunker with a capacity of 120 tons located above the dolomite platforms.

Casting Arrangements.

The ordinary casting of ingots is done by an electrically-operated casting car with ladle saddles running on cantilever arms, designed in such a way that the ladle can be operated to follow the tipping movement of the converter when its content of steel is poured into the ladle. In the plant in question all casting from the car is done in casting pits alongside the car track. These cars are often required also to cast into moulds standing on wagons on a track parallel with the car track, and the design can easily be arranged to meet such demands.

The track for the casting car is made of extra heavy cast-steel U-shaped blocks, securely bolted to the concrete foundation.

The basic-Bessimer plant was built by the Demag of Duisburg. This firm has developed all along the construction of steelworks in Germany, and in the first place influenced decisively the design of converter plants. As far back as 1879, as soon as the epoch-making invention of Thomas and Gilchrist became known, the Demag recognised the far-reaching importance of this invention with reference to Germany and succeeded, backed up by their experience in connection with the construction of acid-Bessmer steelworks, in building the first steelworks working on this new process. Since then they have constructed quite a number of basic-Bessemer (Thomas) works and in all have supplied 92 converters and 46 round mixers.

Corrosion in Tar Stills.—In "Stahl und Eisen." Report No. 220 of the Materials Sub-committee of the German Ironmasters' Association, on "Corrosion Phenomena in Tar Stills and Retorts" is published. The Report describes various observations of corrosion on by-product retorts and gives experiments designed to explain the causes of such corrosion. Practical tests of 3,000 hrs.' exposure to the vapours distilled were made with various low-alloy steels and a cast iron, which were found almost equivalent in behaviour, except that the cast iron was the most resistant. Its price and weight, however, do not allow its use in most retorts. A sprayed aluminium coating was also very satisfactory. Pure phenols had no corrosive action, but ammonium chloride was very deleterious. Ordinary steels possess practically the same corrosion resistance. Special attention was also given to the shape of the corrosion pits in the materials, which in various plants have been found to differ according to the mixtures distilled.

F.B.I. Register of British Manufacturers.—The Federation of British Industries has issued the 13th annual edition of its Register of British Manufacturers, 1933-34, which contains the usual exhaustive and up-to-date information of the organisation and membership of the Federation, a list of manufacturers classified under products and services, an alphabetical list of companies and firms who are members of the Federation or affiliated trade associations, and an alphabetical list of brands and trade marks.

Alloyed Grey Cast Iron.

By Dr. Ing. Carl W. Pfannenschmidt.
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[German Exchange Paper.]

(Presented on behalf of the Verein Deutscher Eisengiessereien, Giessereiverband.)

(Continued from page 64.)

Influence of Vanadium.

The influence of vanadium needs but a brief reference. Work can be consulted by Piwowarsky,[28] Donaldson,[29] Hatfield, Campion,[30] Challansonnet[31] and Smith.[32] Its influence is somewhat questioned. In the first place, there occurs a property which is difficult to translate into figures, namely, a deoxidation and degasification

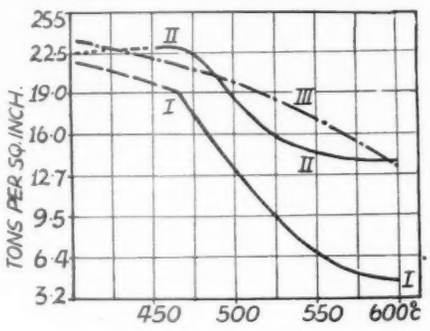


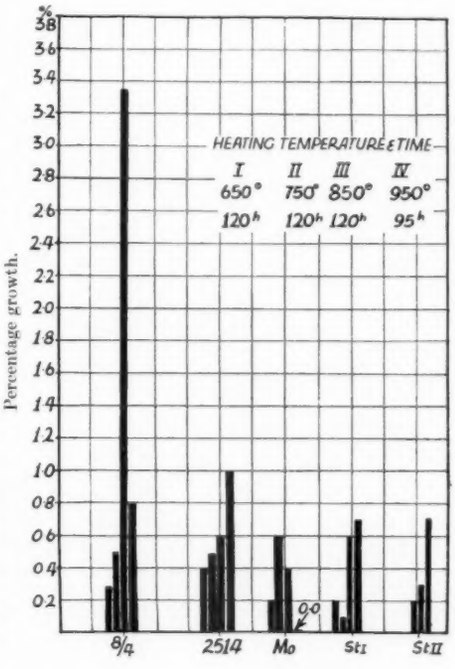
Fig. 12.

Curve I. Maintained elevated for 500 hrs. and tested in tensile at the temperature indicated.
Curve II. After 500 hrs. at the temperature shown, the samples were cooled in the furnace and tested at room temperature.
Curve III. Tested at the temperature shown without any prolonged heating. Composition: T.C., 2.96; Gr, 2.59; Si, 2.53; Mn. 0.78; S, 0.11; P, 0.06, and Ni, 0.96 per cent. (From MacPherran & Krueger.)

due to great affinity for oxygen. In regard to the deoxidation of cast iron—considered generally—the author found, in agreement with Piwowarsky, and in the making of electric cast iron, that a low carbon charge, after superheating and deoxidation, showed first and foremost a notable improvement in the transverse strength values. This, so far as it goes, is a satisfactory feature, since it is precisely at low carbon content and by reason of the dendritic graphite formation which then appears, that one meets with unfavourable transverse strength figures; this was established by Bardenheuer and Zeyen[33] following laboratory experiments, and has been confirmed by the author[34] in actual practice. The accompanying decrease in porosity has been adverted to especially by Smith. He also believes that one can reckon upon an improvement of the wear properties by reason of the carbide-forming action. Myhre[35] confirms this: similar 3,000-h.p. two-cycle engines, fitted in two motor-driven ships, were at one time provided with good unalloyed cast-iron cylinder liners, and at another time with vanadium-alloyed liners. After about 5,000 hrs.' run the wear-values were in the ratio of 2 to 1.

Influence of Copper.

In the series of graphite-forming elements, titanium, tungsten, copper, aluminium, should be mentioned in addition to nickel. With reference to the question of corrosion, already referred to above, copper may be given first place; other influences hardly come up for review. In regard to its action on cast iron—steel may here be left out of consideration—work is available by Lipin,[36] Smalley,[37] Rolfe,[38] Denecke,[15] Hamasumi,[39] Steinberg,[14] Piwowarsky and Kötschke[13]. A slight improvement in tensile strength, transverse strength and Brinell hardness is to be noted. Tests made by the author[17] a few years ago showed an improvement of about 40 per cent. in the presence of steam, and of about 15 to 20 per cent. in diluted acids. Since an increase in resistance to corrosion in actual service is a condition frequently insisted upon in apparatus for the utilisation of waste heat, in coolers and certain other apparatus, the researches in this connection have led to practical applications which, it may be added, have not been limited in most cases to copper alone as an alloy. The basic alloy here is of great importance. Fig. 9 shows the dependence of acid attack upon the extent of the silicon content. The location of the transformation point corresponds substantially to that found by Piwowarsky and Kötschke. The corrosion results of a series of different alloys are given in Fig. 10.



SAMPLE	C	Si	Mn	S	P	–	
8/4	3·44	2·43	0·8	—	0·26	—	
2514	3·14	1·22	0·95	0·065	0·42	—	
Mo	3·12	1·20	0·92	0·061	0·40	0·69	
St	2·32	1·07	0·49	0·062	0·30	1·70 Ni	0·52 Cr

Fig. 13.—Growth Tests after Four Reheatings.

Influence of Titanium.

Titanium, like vanadium, has a very good deoxidising action with cast iron. Kennedy and Oswald[40] have dealt with cast iron which is liable to "growth," and have answered the point in the affirmative, following their tests. Bélain[41] has carried out researches with a view to decreasing the oxide, or gas inclusions, and has secured quite far-reaching results. In the first place, the graphite formation is greatly facilitated. Like Piwowarsky,[41] the author has found the greatest improvements with a 0.1 per cent. titanium addition. The graphite formation could be seen in a photograph of the fracture. Wear tests in the dry showed an improvement in the resistance to wear.

Growth of Cast Iron.

The question of the growth of grey cast iron can only partially be reviewed in connection with questions concerning cast-iron alloys. As is well known, growth means a structure-ruining expansion, which can start from 300 deg. C. and is the more intensive the higher the temperature. The phenomenon is influenced by very many factors, for example, by the kind of gases or atmosphere inside the furnace, the mixture used, the heating-up temperature, and, of course, the

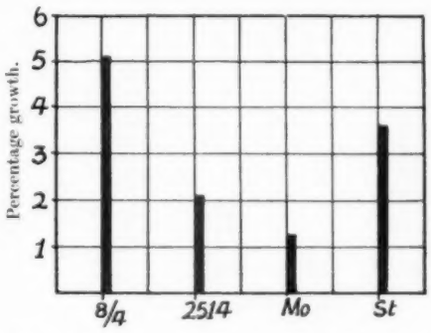


Fig. 14.—Total Growth in Tests 1 to 4.

analysis. The stability of the carbide is also a decisive factor; the influence of the alloy additions, above referred to, also comes into play. There is no doubt that a cast iron can be obtained free from the growth feature, even unalloyed; in this respect great store is set, for instance, on "Lanz-Pearlit" iron. The question of alloy additions, however, is of greater importance from the standpoint of the behaviour of the cast iron at high temperatures, of its life in actual service. Researches by Bach, Rudeloff, Smalley and others have established that a drop first takes place at about 400 to 500 deg. C. and then becomes very sharp.

In the course of researches in this connection, it was found, unfortunately, that an apparatus for making tensile tests at elevated temperatures could not be rendered available. The tests were therefore carried through as prolonged-heating tests. With a view to obtaining wide differences, comparatively high-heating temperatures were decided upon. They were mostly 650, 750, 850 and 950 deg. C. The times varied to some extent, the shortest was 58 hrs. and the duration of the heating process rose up to 120 hrs. The heating up and the cooling down in the furnace are not reckoned in these figures. The tensile test was then made at room temperature. Any direct parallelism between the values obtained in this way and those of elevated temperature tensile tests cannot be arrived at, owing to lack of data in the available literature. Figs. 11 and 12, Nos. II and III, illustrate two parallel tests by MacPherran and Krüger.

So far as wall thickness allowed growth and prolonged-heating tests were made in corresponding castings from which test specimens were taken. For growth tests the bars were heated (see Fig. 13) up to 600, 700 and 800 deg. C. and the variations in length were noted. The ends had been finely ground, the length was ascertained, and the bars were then heated up to the next higher temperature. The original length of all bars of the first test-series was 100 mm. (4 in.) and the thickness 25 mm. (1 in.). The total growth of the first four test-series is shown in Fig. 14.

The growth tests of nickel-chromium alloyed material were made quite independently with two specimens from exactly the same material each time, and repeated several months later, up to 800 deg. C. (see St. II in Fig. 13). Agreement was considered as satisfcatory.

Looking at the Figs. 14 and 16, an important

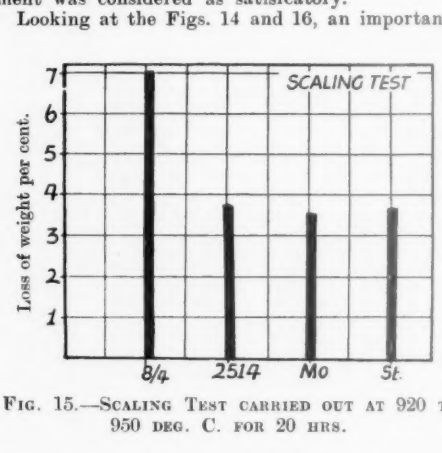


Fig. 15.—Scaling Test carried out at 920 to 950 deg. C. for 20 hrs.

difference regarding the percentage of growth can be seen. Dr. Scheil has studied this type of growth (Archiv f. Eisenhüttenwesen Bd.6, S.61). It can be shown that the amount of growth depends upon the cross-sectional area of the test-bar. This seems to be the reason why the smaller bars (Fig. 16) show only about half the amount of growth.

Scaling Tests.

Scaling tests were carried out on the same samples (see Fig. 15). The heating furnace was so arranged that an oxidising atmosphere was obtained. The scale formed was carefully scraped off and the difference in weight recorded. The unalloyed material (marked 8/4) had become so thoroughly scaled owing to the action of the preceding four growth-test experiments that a trustworthy record concerning this could not be arrived at. Smaller pieces, 25 mm. (1 in.) in height, were taken from fresh material, and a repeated heating test was made with these over 20 hrs. in duration, at 920 to 950 deg. C. (Fig. 16), followed by a scaling test.

In order to study the influence of all these growths and scaling tests on the micro constitution, the bars were examined microscopically. Fig. 17 shows the microstructure of the Cr-Ni-alloyed test-bar "St" (see Figs. 13-18). Two zones were noted, the pearlite zone of the outside was completely decomposed (shown on the

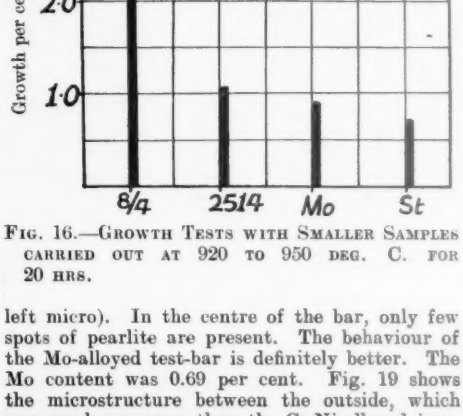
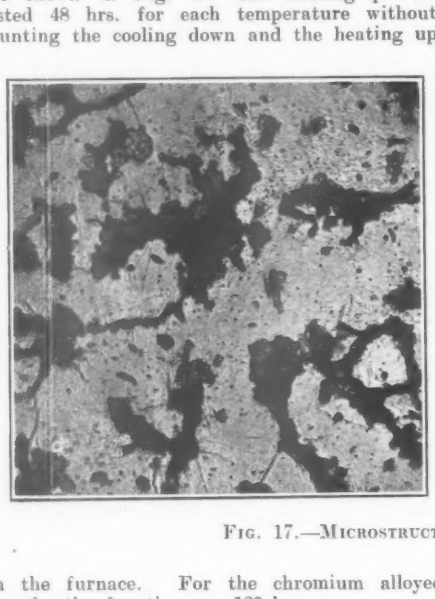


Fig. 16.—Growth Tests with Smaller Samples carried out at 920 to 950 deg. C. for 20 hrs.

left micro). In the centre of the bar, only few spots of pearlite are present. The behaviour of the Mo-alloyed test-bar is definitely better. The Mo content was 0.69 per cent. Fig. 19 shows the microstructure between the outside, which was much narrower than the Cr-Ni-alloyed iron, and the middle, while only small parts of the pearlite are decomposed.

The influence of heating on the tensile strength of a nickel-chromium, a chromium-copper, a chromium alloyed and an unalloyed 25 years' old gas-engine liner, having thick walls, are shown in Fig. 18. The heating process lasted 48 hrs. for each temperature without counting the cooling down and the heating up in the furnace. For the chromium alloyed sample, the duration was 120 hrs.



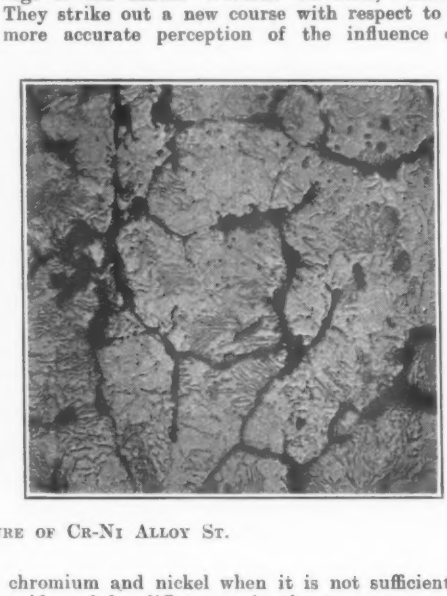
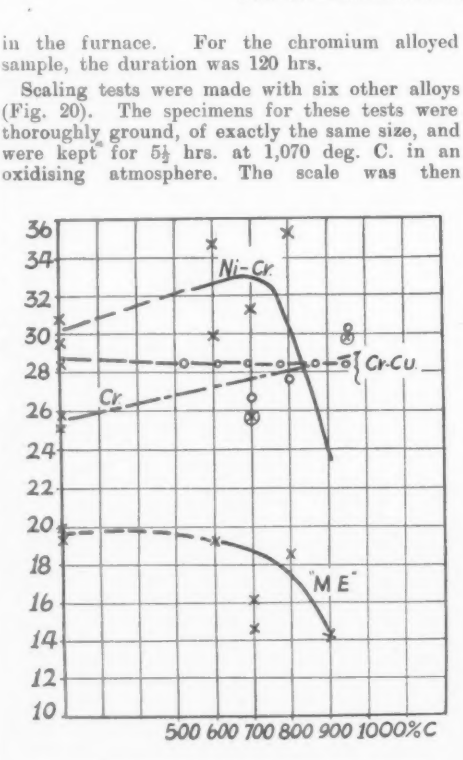


Fig. 17.—Microstructure of Cr-Ni Alloy St.

Scaling tests were made with six other alloys (Fig. 20). The specimens for these tests were thoroughly ground, of exactly the same size, and were kept for 5½ hrs. at 1,070 deg. C. in an oxidising atmosphere. The scale was then removed by rapping and scraping. With reference to the machining of the specimens before the prolonged heating test, it was found that the last ones could be drilled; the first two were white throughout and glass-hard. Two of these were heated for five days, but were even then difficult to drill. All specimens were melted in crucibles.



SAMPLE	C	Si	Mn	S	P	Ni	Cr	Cu
Ni-Cr	2·32	1·07	0·49	0·06	0·30	1·70	0·52	—
Cr-Cu	3·03	1·43	0·73	0·048	0·36	0·67	0·25	0·74
Cr	3·17	1·23	0·82	0·048	0·35	—	0·86	
"ME"	3·22	1·24	0·64	0·097	0·45	—	—	—

Fig. 18.—Influence of Heating on Tensile Strength.

A New Angle.

On concluding the tests there appeared a study by Jungbluth and Pomp, which deals with chromium-nickel alloyed cast iron. ("Proceedings of the Kaiser Wilhelm Institute," 1933.) They strike out a new course with respect to a more accurate perception of the influence of chromium and nickel when it is not sufficiently evidenced by differences in the transverse- and tensile-strength values. Departing from the warping figure which was introduced by Meyersberg ("Kruppsche Monatshefte," 1931), two coefficients for each bending curve are calculated by a formula derived from a graduated scale. The one value, *a* (cotangent), is a measure for the rising of the curve; the second, *b*, a characteristic of the bend. The smaller is *b*, therefore, the smaller the bend, the more the material is comparable to steel. Among other points, the study reveals a stiffening of an increasing nickel addition.

In conclusion, on considering the effect on the strength properties of various alloy additions, leaving out the improvement in all other characteristics, such, for instance, as resistance to corrosion, to wear, long life in service, etc., this effect appears at first sight to be unimportant in so far as the question is viewed from the economical standpoint. It appears to us that the transverse or the tensile strength do not constitute decisive factors for ascertaining the real properties of the material. The author has carried out for over two years, and starting with unalloyed cast iron, a number of researches for arriving at the rotary bending strength. The researches have been extended to alloyed cast iron of composition similar to that of the

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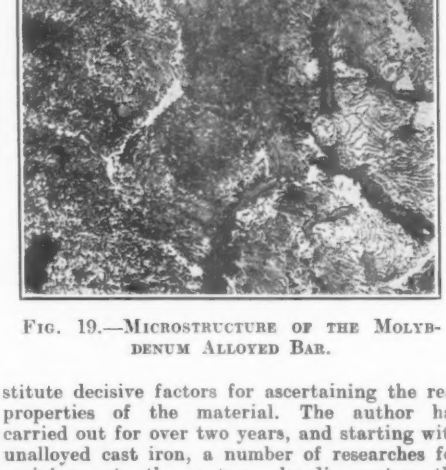


Fig. 19.—Microstructure of the Molybdenum Alloyed Bar.

How to Make Machinable Cast-Iron Welds.

When cast iron is welded with a steel or iron electrode the fusion point is extremely hard and non-machinable, and the surface can only be finished by grinding. For this reason Monel-metal electrodes were introduced and their use is now being extended, experience having shown that, with proper welding apparatus, they give a surface capable of being machined as readily as the parent metal. The Monel-metal rods supplied for the metallic arc-welding of cast iron are coated with a special flux, which protects the weld metal from oxidation and fluxes off any oxides which may be formed. Bare Monel-metal wire is supplied for oxy-acetylene welding, and refined powdered borax should be used as a flux. With gas welding it is necessary to preheat the casting. Where possible, electric welding is recommended.

FIG. 1.—THE BODY OF A LARGE PRESS, SHOWING COMPLETE FRACTURE THROUGH THE TOOL GUIDES AND THE NECK OF THE CASTING.

Monel metal flows very differently from any other welding metal, consequently an operator must accustom himself to its use and not expect to obtain perfect results with the first attempt. The metal cannot be deposited overhead satisfactorily, and as a general rule the work should be flat, although it can be deposited vertically if judgment and caution are exercised. The Monel metal should always be deposited on a cold section of the casting, and a bead not longer than 2 in. laid at one time. Immediately upon breaking the arc, this bead should be carefully peened with a light ball peen hammer. This produces a forged effect in the welded metal and relieves it of the strains due to cooling.

When using a Monel-metal rod to weld a casting in which there is pressure or a vacuum, after the vee or opening has been padded with two layers of metal, all having been peened as above mentioned, the entire weld should be carefully and thoroughly caulked, either by hand or with a pneumatic tool. In addition to the peening of every 2-in. bead, caulking should be continued after every second layer as completed, and when the opening or vee is entirely filled in with Monel metal the whole mass should again be caulked and also gone over with a roughing tool. Particular care should be taken to deposit each and every 2-in. bead on cold metal, so it is therefore necessary either to keep moving from one part of the casting to another, or to cease welding operations until the metal has thoroughly cooled down.

Welding cast iron must necessarily proceed slowly, and where the above suggestions have been conscientiously adhered to by the operator satisfactory results should be obtained.

Flux-coated Monel-metal rods for welding cast iron may be used with any type of electric welding machine, provided a temperature equivalent to the current recommended is maintained. Current at 175 amps. and a short arc is recommended for using Monel metal 0.148 in. ($\frac{5}{32}$ in.) dia., 100 to 130 amps. for 0.120 in. ($\frac{1}{8}$ in.) dia. and 80 to 100 amps. for 0.093 in. ($\frac{3}{32}$ in.) dia. It is most essential that the welding machine used produces the above suggested amperage constantly. It may be necessary with some welding equipment to set the panel switches for a higher amperage than above given in order to ensure an average of those recommended.

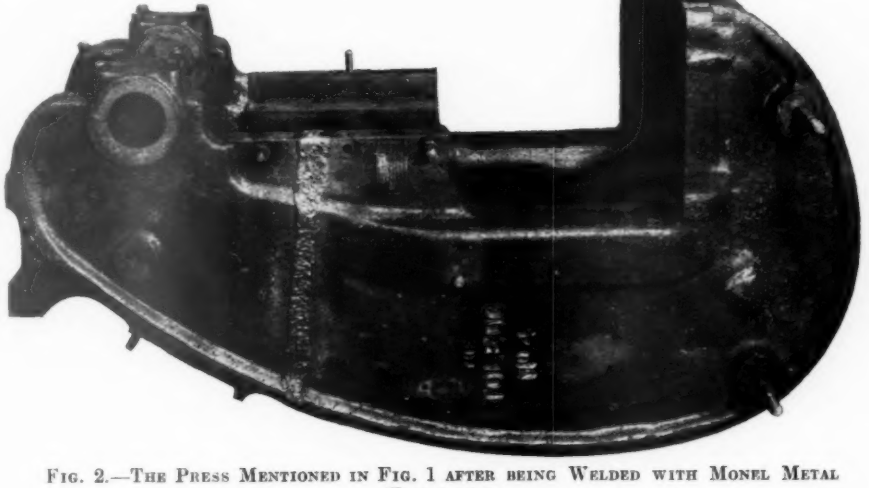
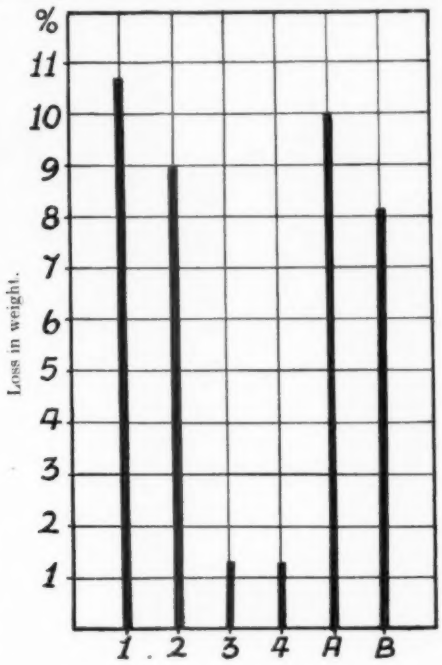


FIG. 2.—THE PRESS MENTIONED IN FIG. 1 AFTER BEING WELDED WITH MONEL METAL ELECTRODES.

Alloyed Grey Cast Iron.

(*Concluded from page* 82.)

materials dealt with in the foregoing. In principle, the alloys showed a marked improvement in the ratio rotary bending strength/tensile strength. In the case of unalloyed cast iron of high quality, this value lies within the limits of 0.35 to 0.45; in that of alloyed cast iron, however, it lies between 0.5 and 0.6. This means that an unalloyed material of about 28 kg. per sq. mm. (17.8 tons per sq. in.) tensile strength shows an alternating stress strength of 12 to 13 kg. per sq. mm. (7.6 to 8.2 tons per sq. in.), whilst with an alloyed one it has been found up to 19 kg. per sq. mm. (12 tons per sq. in.). This notable improvement allows of using alloyed cast-iron engine component parts in many instances which hitherto had been of the domain of steel castings or had been produced by a multiplicity of welding operations. And the improvement in quality is of greater value than the mere increase in mechanical test figures. The author hopes to be able in a few months to report finally on his researches.



SAMPLE Nº	C	Si	Mn	P	S	Ni	Cr	
1	2·54	2·73	n. d.	034	n b	–	3·33	
2	"	2·60	-	030	-	-	3·30	
3	2·69	2·60	-	030	-	-	3·63	1·49%
4	2·60	2·50	-	032	-	4·0	3·0	130%
A	2·40	5·5	-	036	-	-	3·81	
B	2·58	5·1	-	031	-	-	3·72	

FIG. 20.—SCALING TESTS ON ALLOY CAST IRON.

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Estimation of Mn and Cr in Steel.—In "Jernkontorets Annaler," B. KJERMAN and S. BAECKSTROM survey the various analytical methods for the simultaneous estimation of manganese and chromium in steel.

American Progress in the Use of Alloys in Cast Iron.

A POTENTIAL STRENGTH OF 60 TONS.

Mr. F. B. Coyle's Paper* which was presented in a condensed form by Mr. V. Delport at the Cardiff Conference, was discussed by several recognised authorities on alloyed cast iron, including Mr. Oliver Smalley, who has been living in America for some time. The discussion was opened by Mr. Smalley, who commented that the main value of the Paper was from the industrial angle, and said that in that there were two Papers dealing with alloy cast iron at this session it was probably not out of place to refer to the methods of recording the effects of certain special metals. Despite all the published information on the effects of Ni, Cr, Mo, Cu, Al and so forth, it was questionable if any two authorities agreed or if any user of alloys would agree as to the most economical and effective quantities to give a certain result.

To clarify this condition investigations should be conducted not from a given chemical composition, because it is generally agreed that it is not chemical composition but the physical constitution of a grey cast iron that determines its physical properties and service usefulness.

It was true, as had been stated, that small quantities of almost any special metal seemed to improve the grain and strength a few per cent. This was easy to understand if 8 to 10 per cent. of the volume of the cast iron was graphite flakes, *e.g.*, it was said that V and Ti were strengtheners of grey cast iron. But were they? They would improve the strength of any particular grey cast iron only so long as they were able to reduce the quantity and effect a better distribution of the graphite. One might state that grey cast iron has a potential strength of 60 tons per sq. in., which presupposes a cast iron where the free graphite has not mechanically weakened the matrix. If, as in ordinary grey iron, the graphite occupies 9 per cent. of the volume, then the strength may fall to 5 tons per sq. in.; but if the iron is correctly graphitised to start with, it is quite possible to produce 30 tons per sq. in. tensile iron in which all alloys are absent; hence one should not say that an alloy is a strengthener unless evidence is available showing the physical constitution of the iron before the alloy addition, for if the same physical constitution had been obtained in the cast iron without the alloy, the chances are it would have had the combination of properties after the alloy addition.

Where Alloying is Indispensable.

Dr. Everest, in referring to Coyle's Paper, said that he must first take up the cudgels with Mr. Smalley concerning the value of the Paper as a whole. The latter gentleman had condemned the Paper as lacking fundamental information and savouring, perhaps, too much of the industrial aspect. In his own opinion, Dr. Everest said that the Paper did not aim in the least to present fundamental technical data; this had been done adequately elsewhere. The Paper aimed to give a record of the development of alloy cast irons in the States and to present before the Institute of British Foundrymen some of the results which the new alloy cast irons were giving in service. From the latter point of view Dr. Everest thought that the Paper was both extremely interesting and valuable, and, amongst those members of the Institute who were interested in alloy cast irons, many would find very valuable suggestions contained in the data given for the various applications. Mr. Smalley had seemed to suggest that several of the results presented could quite readily be obtained by means other than the use of alloys. Dr. Everest agreed that this was, perhaps, the case in connection with a few of the applications, but, even in these cases, in his opinion, the use of alloys was well justified when it enabled a foundryman to attain the results without resorting to other more complicated and perhaps inconvenient methods. In many of the applications, however, the use of alloys had definitely presented the foundry industry as a whole with types of cast iron which had not hitherto been available.

Alloyed Cast Iron and Cylinder Wear.

Mr. Smalley had made some reference to cylinder liners, and this seemed to the speaker to be an outstanding point in which the use of alloys had enabled newer irons to be developed to meet the modern severe conditions. The martensitic cast-iron liner as attained by the use of nickel was giving, in the automobile industry, results far exceeding any which had been obtained previously. He mentioned, for example, that martensitic liners "as-cast," were now giving regularly, in certain classes of vehicle, lives of 10,000 miles per thousandth of an inch diametrical wear, as against only 2,000 to 3,000 miles for a more ordinary iron, and this surely gave ample evidence of the value of the alloy addition in enabling the superior structure to be attained.

The Paper contained many valuable suggestions both in connection with production, as, for example, the reference to the use of nickel additions to eliminate lengthy and costly ageing processes in connection with large castings, and also relating to the service given by special castings as, for example, in connection with the data given on dies.

A 30-Ton Cast Iron.

One of the most interesting parts of the Paper, however, was that referring to high-strength cast irons, and Dr. Everest especially commended the attention of members to Fig. 10, which showed that, by a combined nickel and silicon treatment of cast irons, very high strengths indeed could be obtained. Thus, members who were fortunate enough to visit the Foundry Exhibition in London would perhaps have noticed the evidence on at least three stands that these high-strength irons were becoming known in Great Britain. He referred especially to a test-bar of an iron treated with nickel and silicon which had broken at a tensile strength of 31.5 tons per sq. in., representing the iron "as-cast" direct from the ladle and not subsequently treated in any way. It had been found that such iron heat-treated would give even more surprising results, as, for example, strengths of 40 tons per sq. in., thus approaching Mr. Smalley's ideal of 60 tons. On another stand there had been a picture of a crusher frame weighing 15 tons which had been made in a nickel-treated cast iron. The test-bars from this casting showed strengths of 25 to 26 tons, whilst, as a check on the metal, test-pieces had been machined from the bottom of the shrink in one of the 9-in. dia. risers, this obviously representing the worst metal in the casting. The strength at this point had been found to be just over 20 tons and gave clear evidence that the casting as a whole would be expected to show strengths in the range of 22 to 23 tons in all sections.

As a further example of the use of alloys in widening the field of application of cast iron, reference could be made to the white and chilled irons described by Coyle. In an ordinary white iron there are essentially two constituents, cementite and pearlite having Brinell hardnesses of 700 and 250 respectively. By the use of nickel it had been found that the pearlite constituent could itself be hardened up to a figure approaching 700, so that, whereas previously the ultimate hardness of the casting was the mean between the two figures mentioned, white and chilled iron were becoming available to-day in which the hardness of the whole had been increased by 200 to 300 points to a figure approaching 700. Coyle mentioned the application of this iron to chilled rolls and this was obviously an interesting application. Dr. Everest mentioned, however, that a word of warning was necessary, chilled rolls presenting many problems both to the ironfounder and the roll engineer and, although a great deal of progress had been made in this direction, it would still be very unwise to suggest that the full advantage of the alloy additions could be achieved merely by making the addition suggested.

Finally, Dr. Everest expressed the feeling that the Institute of British Foundrymen were deeply indebted to Mr. Coyle for the valuable data which he had presented in this Paper, and he felt sure that the exchange of such information could lead only to a better understanding of the technical problems involved in foundry work, and to an increased field of usefulness for cast iron generally.

Cylinder Life.

Mr. T. R. Twigger, referring to the statement in the Paper that several American producers claimed that the use of alloying elements had increased the resistance to wear in alloyed cylinder blocks two to seven times that of plain-iron blocks, said he believed that was different from the experience in this country. He agreed with Dr. Everest that the consensus of opinion was fairly definite that there was a considerable improvement when using martensitic iron in cylinder liners, but generally the improvement was to the extent of not much more than 100 per cent. increased life over that of ordinary cylinder iron. Such increase, which was really a great advance, seemed to apply only to liners with a definitely martensitic structure, produced either by a high nickel addition or more generally by the hardening and tempering of material having only a very small percentage of nickel.

With regard to the creep characteristics referred to in the Paper, he asked what was meant by the statement that the few tests made indicated that low-carbon and alloy cast irons showed marked superiority when subjected to a working stress of 45 tons per sq. in. between 371 and 454 deg. C. He wondered whether the statement was a mistake.

The President (Mr. C. E. Williams) drew attention to the fact that the Paper was a review of American progress in the use of alloys in cast iron, and it was not claimed by the author that all the information given in it was brand new. It was interesting and instructive and would help foundrymen in this country, and a debt of gratitude was due to their American friends. He asked Mr. Delport to convey to Mr. Coyle and his colleagues the Institute's appreciation of the Paper.

Age-Hardening of Metals.—To the "Science Reports of the Tôhoku Imperial University," T. Kawai contributes a Paper on "The Serrated Discontinuity on Load-Extension Diagram and Age-Hardening of Metals and Alloys." This serrated discontinuity in the load-extension diagram for high-temperature tensile tests has been known for many years, but no reasonable explanation has yet been given. The present writer studied this phenomenon in connection with the age-hardening of cold-worked metals and alloys, and found that only the metals which undergo age-hardening after stretching show a serrated discontinuity on the load-extension diagram, when they are tested at a temperature, at which the age-hardening is significant. From this result he explained the phenomenon by a successive action of yielding and ageing caused thereby.

* Foundry Trade Journal, July 6, 1933, page 7.

This Week's News in Brief.

Trade Talk.

MESSRS. ALEXANDER HALL & COMPANY, LIMITED, Aberdeen, have secured an order for a tug for the Buenos Ayres Great Southern Railway, to operate at Bahia Blanca.

AFTER BEING CLOSED for about 14 months, work is to be resumed at the Otto Vale by-product ovens, Blaydon Burn, belonging to the Priestman Collieries, Limited.

THE TWO FURNACES which were damped down a few weeks ago at the Gartsherrie works of William Baird & Company, Limited, were put into blast again last week.

WORK IS TO BEGIN shortly on a scheme for improving the approaches to the London docks by reconstructing a number of bridges. The scheme is estimated to cost £188,960.

MESSRS. SIMON-CARVES, LIMITED, Cheadle Heath, have received a repeat order for an electrostatic detarring unit from the Gas Light & Coke Company for installation at their Southall works.

A BURGLAR SCARE occurred in the premises of Messrs. William M'Phail & Sons, Violet Grove Foundry, Grovepark Street, Glasgow, on Thursday night. The police surrounded the building and made a thorough search, but no sign of any intruder was found.

A PETITION has been presented for the winding-up of the Darlington Rustless Steel & Iron Company, Limited. The petition is presented by Mr. B. A. Holland, of 4, More's Gardens, Chelsea, and is directed to be heard on October 9 at the Royal Courts of Justice, Strand, W.C.

IT IS ANNOUNCED by the Scottish Manufactured Iron Trade Conciliation and Arbitration Board that, in consequence of an examination of the employers' books for May and June, which show the average net selling price as £9 13s. 0.24d., there will be no change in the wages of the workmen.

AN ACCIDENT OCCURRED within the tube shop of Messrs. Stewarts and Lloyds' Vulcan Works, Motherwell, when Mr. Robert Gilmour, who was working on top of a pile of tubes, lost his balance and fell on to the floor, sustaining two fractures of the leg and a fracture and dislocation of the arm.

ARDROSSAN DOCKYARD, LIMITED, launched the single-screw steamer "Arran," which has been built for Messrs. Clyde Cargo Steamers, Limited, Glasgow. The vessel is intended for trading between Glasgow and Arran and other Firth of Clyde ports, and is 120 ft. in length. The engines, capable of developing 480 i.h.p., have been supplied by Messrs. Aitchison, Blair, Limited, Clydebank.

IT IS REPORTED that Messrs. Hick, Hargreaves & Company, Limited, Soho Ironworks, Bolton, have acquired the goodwill, patterns and drawings of Galloways, Limited, Knott Mill Ironworks, Manchester, which includes also the goodwill, patterns and drawings of Messrs. John Musgrave & Sons, Globe Ironworks, Bolton, and drawings of engines formerly made by John & Edward Wood, of Bolton.

MESSRS. HALLEY MOTORS, LIMITED, Yoker, near Glasgow, have received an order from the Director of Navy Contracts to construct a fire engine for service at H.M. Dockyard, Malta. The engine will be very similar to those recently delivered by Messrs. Halley Motors to the Glasgow Corporation Fire Brigade. The pump will be capable of delivering from 650 galls. of water per min. up to 1,000 galls. per min.

AT A SITTING of the Falkirk Dean of Guild Court last week, a petition was presented by Mr. Walter Mitchell, managing director of the Grahamston Iron Company, Limited, for an extension to the foundry. The Dean of Guild, in announcing the granting of the petition, extended congratulations to the company, and said it was gratifying to see foundries beginning to extend their premises, and he hoped this augured well for the future.

THE GOLD MEDAL of the North-East Coast Institution of Engineers and Shipbuilders has been awarded to Mr. W. T. Bottomley for a Paper entitled "Radiation in Boiler Furnaces." Awards have been granted by the Council to the undermentioned graduate members for Papers read during the current session:—Messrs. W. Spencer Paulin, A. T. S. Sheffer, L. P. Gibson, N. Milne Hunter, S. G. Irving, J. C. Dixon, A. Henry, L. H. W. Wright, and N. H. Denholm.

THE PARTNERSHIP between Mr. G O. Donovan and Mr. W. Donovan, who during the past 25 years have traded as Donovan & Company, electrical manufacturers and suppliers, is being dissolved for family reasons and the business is being converted into the Donovan Electrical Company, Limited, with offices at 46, Great Charles Street, Birmingham, and works at Stechford. The two partners will, as joint managing directors, continue to take the same interest in the new company as in its predecessor, and there will also be admitted to directorships Mr. H. Varnom, manager of the firm, and Mr. E. T. G. Donovan and Mr. J. W. Donovan.

AN IMPORTANT AGREEMENT has, it is understood, been reached between pig-iron producers in Japan and the Kishimoto Shoten, the largest importer of Indian pig-iron, with the object of eliminating mutual competition. The principal points of the reported agreement are that the Kishimoto Company will become the official agent of the Pig-iron Co-operative Distributing Association of Japan; the volume of Japanese pig-iron handled by the company will be limited to about 50,000 tons a year; imports of Indian pig-iron to be prohibited, but permission may be given for a certain amount whenever supplies in Japan are scarce, the Indian pig-iron thus brought in to be distributed through the Co-operative Distributing Association.

ANOTHER SCOTTISH FIRM has prepared a scheme to modernise its blast-furnace plant. This company is the David Colville-James Dunlop merger, which controls collieries, a blast-furnace plant at Clyde Iron Works, Tollcross, and steelworks at Clydebridge, Dalzell and Glengarnock. It is proposed to modernise the blast-furnace plant at Tollcross and to use the coal produced at Steppe Colliery for coking purposes. The pig-iron will be used at the firm's steelworks. The plant contemplated will be utilised for the manufacture of by-products, including gas, which will probably be offered to Glasgow Corporation on favourable terms. The scheme has been in abeyance for more than two years, but now that the merger details have been adjusted the directors intend to proceed at the earliest opportunity. Clydebridge steelworks form the largest producing unit in Scotland. The new scheme will insure an ample supply of pig-iron from Tollcross, which is situated on the north side of the River Clyde, a short distance from Clydebridge. It has been suggested that a bridge will be constructed over the River Clyde to facilitate the transport of pig-iron and other materials from the blast furnaces to Clydebridge.

New Companies.

Dudley & Dowell, Limited, Olive Lane, Blackheath, Birmingham.—Capital, £6,000. Ironfounders and engineers. Directors: W. E. Dudley and P. Dowell.

Campbell Conveyor & Engineering Company, Limited.—Capital, £1,000. Directors: A. Frampton, "Arundel," 1, Park Avenue, Bromley, Kent; H. Campbell and K. P. Frampton.

H. Salt & Company, Limited, 13, Court Price Street, Birmingham.—Capital, £400. Manufacturers of and dealers in alloys, metal ingots, castings, etc. Directors: H. Salt and R. K. Vaughan.

Lynton Wheel & Engineering Company, Limited, Kerfoot Street, Longford Bridge, Warrington.—Capital, £7,000 in £1 shares, to take over the business of the Lynton Wheel & Tyre Company, Limited, formerly carried on at Warrington. Directors: H. Hoyle, A. Haworth and C. Marsh.

Contracts Open.

Finland, September 1.—Three Diesel engines, for the State Railways. The Department of Overseas Trade. (Reference G.Y. 12,817.)

Cairo, September 6.—Cast-iron sealed sewage mains, for the Egyptian Ministry of Public Works. The Department of Overseas Trade. (Reference G.Y. 12,849.)

London, N., September 14.—Supply and erection of four heavy-oil engines with centrifugal pumps, for the Metropolitan Water Board. The Offices of the Board, Chief Engineer's Department (Room 173), 173, Rosebery Avenue, E.C.1.

Cairo, September 7.—Sand-blasting and metal-spraying equipment, which includes an internal-combustion engine and air compressor, etc., for the Egyptian Ministry of Public Works. The Department of Overseas Trade. (Reference G.Y. 12,844.)

Personal.

MR. RALPH SILLARS is retiring from the position of joint managing director of Messrs. Warner & Company, Limited, Middlesbrough. He will, however, retain his seat on the board of directors as chairman. Mr. Sillars joined Messrs. Warner & Company 52 years ago, and has been managing director since the firm was made a limited company in 1900, and chairman since 1920.

MR. JAMES S. HOLLINGS, deputy managing director of the British (Guest Keen Baldwins) Iron & Steel Company, Limited, has been appointed joint managing director of the company with Sir Charles Wright, Bt. MR. I. F. L. ELLIOT, previously the London manager of the company, has been appointed assistant managing director. Mr. James S. Hollings became associated with Baldwins, Limited, in 1924 under Sir Charles Wright as technical adviser to that firm, and has been a director of the British (Guest Keen Baldwins) Iron & Steel Company, Limited, since its inception. He is also a director of the Brymbo Steel Company, Limited (managing), the Oxfordshire Ironstone Company, Limited, the Sinai Mining Company, Limited, the Briton Ferry Works, Limited, and other companies.

Wills.

JENKINS, H. C., chairman of the Mining Engineering Company, Limited, Worcester £46,445

MOIR, SIR ERNEST W., a director of Callender's Cable & Construction Company, Limited, and the Anchor Cable Company, Limited £406,947

MARSH, H. P., of Sheffield, chairman of Messrs. Marsh Bros. & Company, Limited, and of the Effingham Steel Works, Limited £57,119

Obituary.

MR. ALEX. J. CRUICKSHANK, of Messrs. Cruickshank & Company, Limited, Denny Iron Works, died last week at his home, 63, Glasgow Road, Denny, at the age of 50.

MR. CLIVE EARNSHAW HOWELL, a director until his retirement about four years ago of Messrs. Howell & Company, Limited, tube and steel manufacturers, of Sheffield, died recently at his home in Kent.

WHILE AT WORK in No. 6 department of the Singer Manufacturing Company's factory at Kilbowie, near Glasgow, Mr. Robert Crawford collapsed suddenly and died before medical aid could be obtained.

THE DEATH HAS OCCURRED at his home in Aberdeen of Mr. James Mitchell, a well-known ornamental and general blacksmith. Hailing from the Deeside district, Mr. Mitchell went to Aberdeen at an early age and commenced business, and in course of time came to be recognised as a specialist in ornamental and intricate smith work. He was 59 years of age.

The Handling of Refractories.

By an oversight on our part, we omitted to state that the information contained in this impressive little article, published in our last week's issue, was the subject matter of the Refractories Bulletin No. 18, issued by John G. Stein & Company, Limited, of Bonnybridge, Scotland. May we add that these Bulletins have invariably contained much matter of extreme interest to our readers. We are sincerely sorry for this lapse on our part.

A NEW FORM OF STEEL with a marble surface is announced by the Mellon Institute, Pittsburgh. The stone effect is imitation, made by a laminated resin surface woven inseparably with the metal. Any other finish made with the new laminated resins can be added. In this manner steel can be either paper-coated or cloth-covered. It can even be made to imitate wood. Decorative finishes are already applied to steel by other methods, but this is claimed to be the first process to make the surfaces an integral part of the metal, since the new surface fuses with both the steel and the covering. The invention, it is claimed, brings the era of the all-steel house nearer to realisation.

Raw Material Markets.

Although, of course, business is restricted by the usual holiday interruptions, conditions in the iron and steel markets remain fairly satisfactory, and the autumn session is looked forward to with confidence. Generally speaking, activities will not be fully resumed at least until the end of August. A good volume of inquiries is being received from overseas markets, and it is felt that a large number of export orders only await the clearing-up of the international financial situation.

Pig-Iron.

MIDDLESBROUGH.—The ironmasters in the Cleveland area are quite satisfactorily placed. Stocks of pig-iron have been reduced to the workable minimum, and heavy tonnages have been sold ahead over the next few months. The Glasgow Fair holidays are now ended, and deliveries of iron to that area have been resumed. Export business is also on an improved scale, although the prices quoted are very low. Home prices remain unchanged. For delivery in the Middlesbrough area, No. 1 Cleveland foundry iron is quoted at 65s. per ton, No. 3 Cleveland G.M.B. 62s. 6d. and No. 4 foundry and No. 4 forge 61s. 6d. per ton. North-Eastern buyers outside the Middlesbrough area have to pay an extra 2s. per ton.

In the East Coast hematite market there is a distinct possibility of an advance in home prices, as discussions have been going on between the producers with a view to a comprehensive price agreement, including, it is thought, reduced export quotations. This possibility has inspired considerable buying by consumers, particularly in South Wales. For the moment, however, quotations remain unchanged at 59s. for mixed numbers and 59s. 6d. for No. 1 quality.

LANCASHIRE.—Market operations have fallen away to a certain extent, owing to town-holiday interruptions in many parts of Lancashire and to the fact that many consumers are already covered for some period ahead. Pig-iron quotations for delivery in the Manchester zone are as follow:—Derbyshire, Staffordshire and North-East Coast brands of No. 3 iron, 67s. per ton; Northants, 65s. 6d.; Derbyshire forge iron, 62s.; Scottish foundry, about 80s.; East Coast hematite, 74s. to 75s.; West Coast, 80s. 6d. Indian foundry iron is offered for delivery to Lancashire users in the region of 70s. per ton.

MIDLANDS.—Most of the ironfoundries in this area are closed this week for the holidays, but good supplies of iron have been booked for delivery after next Monday, thus assuring a satisfactory start to the autumn trading. Prices are unchanged at 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, less 5s. per ton for forge pig-iron; delivered to Birmingham and Black Country stations, less rebate for large consumers. Cleveland No. 3 is available in this area at 66s., but Continental foundry iron is not competitive. Medium-phosphorus irons, including Scottish, are round about 85s. per ton, low-phosphorus from 80s. to 90s., and refined pig-iron from £5 to £6 15s. per ton, all delivered Black Country district.

SCOTLAND.—Deliveries of iron to founders in the Glasgow district have now been generally resumed. It is stated that many light-castings makers are now working full time, partly owing to "rush" orders connected with housebuilding. There is no change in prices. The official minimum for No. 3 foundry of 65s. f.o.t. furnaces is still in force, with an extra of 2s. 6d. for No. 1. No. 3 Middlesbrough is obtainable at 65s. 3d. f.o.t. Glasgow area and 62s. 3d. f.o.t. Falkirk area, other English foundry irons being obtainable at 2s. 3d. per ton below these figures.

Coke.

Foundry-coke buying is still limited to small parcels for early delivery. Current quotations, delivered in the South Staffordshire area, are approximately as follow:—Best Durham coke, 36s. to 38s.; other grades, 34s. to 35s.; Welsh coke, according to analysis, 28s. to 45s.; Scottish coke, 39s. to 40s. per ton.

Steel.

Generally speaking, the steel markets continue to display a fairly confident tone, the holiday interruption being less felt this year than in recent years. In the semi-finished steel section, the home manufacturers are well placed for orders, and are making firm quotations for future dates. The finished-steel market is not very active at the moment. One or two sales of Continental small steel bars have been reported at prices below those quoted by the British works.

Scrap.

In the Cleveland area cast-iron scrap remains in rather poor demand. In the Midlands, however, the ironfounders are fairly busy and prices are firm. Slightly more scrap is changing hands in Scotland and prices have firmed up since the conclusion of the holidays. Generally speaking, there seems to be a gradually-improving demand for most grades of cast iron, and market prices have displayed an upward tendency.

Metals.

Copper.—The copper market is displaying a fairly steady tone, in spite of the several spasms of liquidation that have taken place and the fact that buying by consumers has been at a low level. In spite of the holiday interruption, prices continue to display an upward tendency. The market is still under the influence of the uncertain dollar situation.

The week's prices have been as follow:—

Cash.—Thursday, £36 13s. 9d. to £36 15s.; Friday, £36 16s. 3d. to £36 17s. 6d.; Tuesday, £36 11s. 3d. to £36 13s. 9d.; Wednesday, £36 12s. 6d. to £36 13s. 9d.

Three Months.—Thursday, £36 18s. 9d. to £37; Friday, £37 to £37 1s. 3d.; Tuesday, £36 16s. 3d. to £36 17s. 6d.; Wednesday, £36 16s. 3d. to £36 17s. 6d.

Tin.—Messrs. Rudolf Wolff & Company report that the statistics published recently, showing a decrease in the total visible supply of about 1,800 tons, were not quite so good as had been anticipated, and their publication had, if anything, a rather weakening effect on the course of prices. Consumption generally is reported to be well maintained, but trade demand has been quiet, both in this country and on the Continent, as also in the United States of America. The continued quietness of the market must be attributed to the unsettled conditions in America and the indefinite industrial outlook generally, for which reasons buyers are inclined to withhold, pending fresh developments. A steady undertone is maintained and there seems little probability of any material setback, but if prices are to substantially advance some fresh stimulus must be provided.

Daily quotations:—

Cash.—Thursday, £214 10s. to £214 15s.; Friday, £214 15s. to £214 17s. 6d.; Tuesday, £214 10s. to £214 12s. 6d.; Wednesday, £215 8s. 9d. to £215 10s.

Three Months.—Thursday, £214 17s. 6d. to £215; Friday, £214 17s. 6d. to £215; Tuesday, £214 12s. 6d. to £214 15s.; Wednesday, £215 7s. 6d. to £215 10s.

Spelter.—Although the consumption of spelter in this country is still fairly well maintained, there has been a falling-off in the trade demand. This, coupled with the arrival of unusually heavy supplies in this country, has tended to keep prices down. Quiet conditions still rule on the Continent.

Price fluctuations:—

Ordinary.—Thursday, £16 16s. 3d.; Friday, £16 15s.; Tuesday, £16 10s.; Wednesday, £16 15s.

Lead.—Messrs. Henry Gardner state in their weekly report that the severe bout of liquidation which all the markets experienced last week caused August lead to fall to £12 5s., but on the decline consumers purchased confidently, and an immediate recovery was brought about. This metal does not display much resiliency, and it requires consumption to be continued on a good scale for confidence and activity to be maintained.

Daily market prices:—

Soft Foreign (Prompt).—Thursday, £12 12s. 6d.; Friday, £12 7s. 6d.; Tuesday, £12 2s. 6d.; Wednesday, £12 5s.

Company Meeting.

W. & T. Avery, Limited.

Presiding at the annual meeting of Messrs. W. & T. Avery, Limited, held in Birmingham last week, Sir J. Fortescue Flannery, Bt. (chairman), said that the crushing taxation in this country continued to work in restraint to trade, and he hoped that in the near future the Chancellor of the Exchequer might see his way to a reduction in taxation, with the result of an increase and not a decrease in revenue. Decreased purchasing power at home had not been without its effect upon their business, but they had been able to increase their efficiency in manufacture and maintenance and to carry out active development work.

Imported Billets for Making Drill Steel.

The Import Duties (Drawback) (No. 10) Order, 1933, issued by the Treasury on Wednesday, August 2, put into operation as from August 4 a scheme for the allowance of drawback in respect of steel billets used in the manufacture of hollow mining drill steel. Certain of the gold-mining companies have a preference for drill steel made in Sheffield from charcoal steel billets imported from Sweden, and the Import Duties Advisory Committee recommend that relief by way of drawback of duty should be afforded for the time being, so that British producers are not placed at a disadvantage in tendering for contracts in which they may be required by specification to use imported material. A White Paper (Cmd. 4402) containing the Treasury Order and the Advisory Committee's report is published by the Stationery Office.

CAST IRON FLANGED PIPES
2 in.—12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone: 3852 (2 Lines). MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

STERLING MOULDING BOXES

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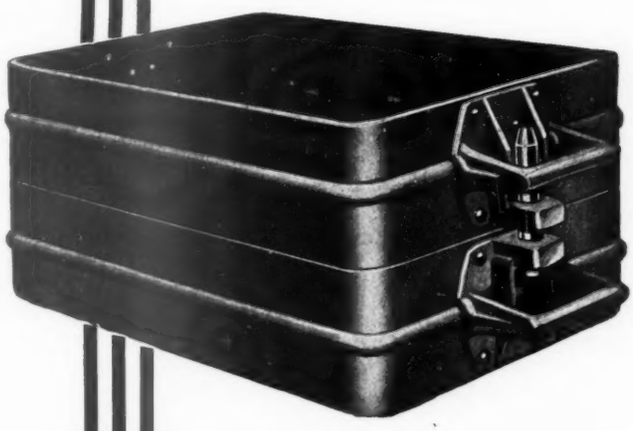

The Sterling Box is more than "just a Moulding Box," it is an accurate tool for producing accurate castings with a minimum of labour and effort

Made from solid ribbed rolled steel

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AGENTS AT MANCHESTER, GLASGOW & NEWCASTLE-ON-TYNE.
BEDFORD

RAW MATERIALS—PRICE LIST.

(Wednesday, August 9, 1933.)

COPPER.

	£	s.	d.
Standard cash	36	12	6
Three months	36	16	3
Electrolytic	41	0	0
Tough	39	0	0
Best selected	39	10	0
Sheets	68	0	0
India	49	10	0
Wire bars	41	10	0
Ingot bars	41	10	0
H.C. wire rods	43	15	0
Off. av. cash, July	37	19	0 13/16
Do., 3 mths., July	38	2	3 1/16
Do., Sttlmnt., July	37	19	4 6/16
Do., Electro, July	41	19	6 2/16
Do., B.S., July	40	19	4 1/2
Do., wire bars, July	42	8	6 8/16
Solid drawn tubes			10 1/2d.
Brazed tubes			10 1/2d.
Wire			7d.

BRASS.

Solid drawn tubes	9 1/2d.
Brazed tubes	11 1/2d.
Rods, drawn	8 1/2d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	8d.
Wire	8d.
Rolled metal	7 1/2d.
Yellow metal rods	4 1/2d.
Do. 4 × 4 Squares	5 1/2d.
Do. 4 × 3 Sheets	5 1/2d.

TIN.

	£	s.	d.
Standard cash	215	8	9
Three months	215	7	6
English	216	0	0
Bars	217	0	0
Straits	220	0	0
Australian (nom.)	—		
Eastern	221	5	0
Banca	220	10	0
Off. av. cash, July	216	15	7 9/16
Do., 3 mths., July	216	12	4 5/16
Do., Sttlmt., July	216	15	2 9/16

SPELTER.

	£	s.	d.
Ordinary	16	15	0
Remelted	16	10	0
Hard	14	10	0
Electro 99.9	19	0	0
English	17	5	0
India	16	10	0
Zinc dust	20	0	0
Zinc ashes	4	5	0
Off. aver., July	17	15	10
Aver. spot, July	17	15	10 9/16

LEAD.

	£	s.	d.
Soft foreign ppt.	12	5	0
Empire	12	7	6
English	13	15	0
Off. average, July	13	10	2 9/16
Average spot, July	13	8	2 1/16

ALUMINIUM.

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	25	15	0
Do., V.M. ex-whse.	25	5	0
Rods	30	10	0

ANTIMONY.

	£	s.	d.	£	s.	d.
English	37	10	0 to	40	0	0
Chinese				26	15	0
Crude				—		

QUICKSILVER.

	£	s.	d.	£	s.	d.
Quicksilver	8	7	6 to	8	17	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	6 10 0
45/50%	12 10 0
75%	18 2 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£15 0 0
Ferro-tungsten—	
80/85%	1/9 lb.
Tungsten metal powder—	
98/99%	2/- lb.
Ferro-chrome—	
2/4% car.	25 10 0
4/6% car.	21 17 6
6/8% car.	19 7 6
8/10% car.	18 17 6
Ferro-chrome—	
Max. 2% car.	30 0 0
Max. 1% car.	31 0 0
Max. 0.70% car.	42 10 0
70%, carbon-free	10 1/2d. lb.
Nickel—99.5/100%	£225 to £230
"F" nickel shot	£202 10 0
Ferro-cobalt	5/6 lb.
Metallic chromium—	
96/98%	2/8 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under 1/4 in. to 1/2 in.	3d. lb.
Do., under 1/2 in. to 1/16 in.	1/- lb.
Flats, 1/2 in. × 1/4 in. to under 1 in. × 1/8 in.	3d. lb.
Do., under 1/2 in. × 1/4 in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.
Bars cut to length, 10% extra.	

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel				2	5	0
Bundled steel and shrngs.	1	17	6 to	2	4	0
Mixed iron and steel	2	1	0 to	2	1	6
Heavy cast iron	2	3	6 to	2	4	6
Good machinery	2	8	0 to	2	10	0
Cleveland—						
Heavy steel	2	2	6 to	2	5	0
Steel turnings				1	11	6
Cast-iron borings				1	2	0
Heavy forge				2	10	0
W.I. piling scrap				2	0	0
Cast-iron scrap	1	19	0 to	2	1	0
Midlands—						
Light cast-iron scrap	1	18	6 to	2	0	0
Heavy wrought iron				2	5	0
Steel turnings, f.o.r.				1	5	6
Scotland—						
Heavy steel				2	0	0
Ordinary cast iron	2	7	6 to	2	8	6
Engineers' turnings				1	12	6
Cast-iron borings				1	12	6
Wrought-iron piling	2	2	6 to	2	4	0
Heavy machinery				2	12	6

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	31	0	0
Brass	19	0	0
Lead (less usual draft)	11	0	0
Tea lead	9	0	0
Zinc	10	10	0
New aluminium cuttings	72	0	0
Braziery copper	28	0	0
Gunmetal	26	0	0
Hollow pewter	135	0	0
Shaped black pewter	100	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	65/-
Foundry No. 3	62/6
„ at Falkirk	62/3
„ at Glasgow	65/3
Foundry No. 4	61/6
Forge No. 4	61/6
Hematite No. 1, f.o.t.	59/6
Hematite M/Nos., f.o.t.	59/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	68/6
„ d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	62/-
„ No. 3 fdry.	66/-
Northants forge	58/6
„ fdry. No. 3	62/6
„ fdry. No. 1	65/6
Derbyshire forge	62/-
„ fdry. No. 3	66/-
„ fdry. No. 1	69/-
Scotland—	
Foundry No. 1	67/6
„ No. 3	65/-
Hem. M/Nos. d/d	66/-
Sheffield (d/d district)—	
Derby forge	59/6
„ fdry. No. 3	63/6
Lincs forge	59/6
„ fdry. No. 3	63/6
E.C. hematite	73/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	80/-
Clyde, No. 3	80/-
Monkland, No. 3	80/-
Summerlee, No. 3	80/-
Eglinton, No. 3	80/-
Gartsherrie, No. 3	80/-
Shotts, No. 3	80/-

FINISHED IRON AND STEEL.

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	9	0	0 to	9	15	0
Nut and bolt iron	6	15	0 to	7	10	0
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, 1/2 in. × 4 in.				13	0	0
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.				8	5	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5 1/2 in.				9	7	6
Rounds under 3 in. to 1/4 in. (Untested)	6	17	6 & up.			
Flats—8 in. wide and over				8	12	6
„ under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates				12	0	0
Hoops (Staffs)	9	10	0 & up.			
Black sheets, 24g. (4-t. lots)				10	0	0
Galv. cor. shts. „				12	10	0
Galv. flat shts. „				13	0	0
Galv. fencing wire, 8g. plain				14	0	0
Billets, soft	5	0	0 to	5	12	6
Billets, hard	6	12	6 to	7	2	6
Sheet bars	4	15	0 to	5	5	0
Tin bars				4	15	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	12 5/8d.
Rods	11d.
Tubes	15 1/2d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1 1/4 to 1/7 1/4
To 15 in. wide	1/1 1/2 to 1/7 1/2
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2 1/2 to 1/8 1/2
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3 1/2
Ingots rolled to spoon size	10d. to 1/6 1/2
Wire round—	
to 10g.	1/4 1/2 to 1/11 1/2

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3 1/2 upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	17.34
No. 2 foundry, Valley	16.50
No. 2 foundry, Birm.	13.00
Basic	17.89
Bessemer	18.89
Malleable	18.39
Grey forge	18.39
Ferro-mang. 80%, seaboard	82.00
O.-h. rails, h'y, at mill	40.00
Billets	26.00
Sheet bars	26.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	1.86
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Steel hoops	1.70
Sheets, black, No. 24	2.25
Sheets, galv., No. 24	2.85
Wire nails	2.10
Plain wire	2.10
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.25

COKE (at ovens).

Welsh foundry	20/- to 22/-
„ furnace	15/- to 15/6
Durham and Northumberland—	
„ foundry	21/- to 25/-
„ furnace	13/3
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		17/-
„	28×20	„	34/-
„	20×10	„	24/4
„	18 3/4×14	„	17/9
C.W.	20×14	„	16/-
„	28×20	„	32/6
„	20×10	„	22/9
„	18 3/4×14	„	16/6

SWEDISH CHARCOAL IRON & STEEL.

	£	s.	d.	£	s.	d.
Pig-iron	£6	0	0 to	£7	0	0
Bars-hammered, basis	£16	0	0 to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0 to	£16	0	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£30	0	0 to	£31	0	0
Faggot steel	£18	0	0 to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0 to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Aug.	3 ..	36	13	9	inc.	5/-
,,	4 ..	36	16	3	,,	2/6
,,	8 ..	36	11	3	dec.	5/-
,,	9 ..	36	12	6	inc.	1/3

Electrolytic Copper.

		£	s.	d.	
Aug.	3 ..	41	0	0	No change
,,	4 ..	41	0	0	,, ,,
,,	8 ..	41	0	0	,, ,,
,,	9 ..	41	0	0	,, ,,

Standard Tin (cash).

		£	s.	d.		
Aug.	3 ..	214	10	0	inc.	5/-
,,	4 ..	214	15	0	,,	5/-
,,	8 ..	214	10	0	dec.	5/-
,,	9 ..	215	8	9	inc.	18/9

Tin (English ingots).

		£	s.	d.		
Aug.	3 ..	215	0	0	No change	
,,	4 ..	215	5	0	inc.	5/-
,,	8 ..	215	0	0	dec.	5/-
,,	9 ..	216	0	0	inc.	20/-

Spelter (ordinary).

		£	s.	d.		
Aug.	3 ..	16	16	3	inc.	2/6
,,	4 ..	16	15	0	dec.	1/3
,,	8 ..	16	10	0	,,	5/-
,,	9 ..	16	15	0	inc.	5/-

Spelter (Electro, 99.9 per cent.).

		£	s.	d.		
Aug.	3 ..	19	7	6	inc.	5/-
,,	4 ..	19	5	0	dec.	2/6
,,	8 ..	19	0	0	,,	5/-
,,	9 ..	19	0	0	No change	

Zinc Sheets (English).

		£	s.	d.	
Aug.	3 ..	25	15	0	No change
,,	4 ..	25	15	0	,, ,,
,,	8 ..	25	15	0	,, ,,
,,	9 ..	25	15	0	,, ,,

Lead (English).

		£	s.	d.		
Aug.	3 ..	14	0	0	No change	
,,	4 ..	13	15	0	dec.	5/-
,,	8 ..	13	10	0	,,	5/-
,,	9 ..	13	15	0	inc.	5/-

AVERAGE MONTHLY PRICES OF STEEL RAILS.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1918	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6
1919	10 17 6	13 7 6	13 7 6	13 7 6	15 0 0	15 10 0	16 0 0	16 10 0	16 10 0	16 10 0	16 10 0	17 5 0	14 12 11
1920	18 15 0	19 5 0	20 7 6	22 0 0	23 0 0	23 0 0	24 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	22 18 11½
1921	23 5 0	20 4 0	18 0 0	17 0 0	15 0 0	15 0 0	14 0 0	14 0 0	14 0 0	11 12 6	10 10 0	10 0 0	15 4 3
1922	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 0 0	8 15 0	8 15 0	8 15 0	8 15 0	9 4 2
1923	8 17 6	9 2 0	10 5 0	10 10 0	10 10 0	10 10 0	9 15 0	9 0 0	8 15 0	8 15 0	8 19 0	9 5 0	9 9 10
1924	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 2 6	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 2 3½
1925	9 0 0	9 0 0	9 0 0	9 0 0	8 15 6	8 10 7½	8 10 0	8 10 0	8 10 0	8 4 0	8 0 0	8 0 0	8 11 7½
1926	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	8 10 0	8 10 0	8 3 11½
1927	8 10 0	8 10 0	8 10 0	8 2 6	8 2 6	8 2 6	8 2 6	8 2 6	8 2 6	8 3 0	8 5 0	8 5 0	8 4 10
1928	8 5 0	8 5 0	8 5 0	8 5 9	8 6 3	8 6 3	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 7 9½
1929	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0
1930	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0
1931	8 9 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 8	8 7 8
1932	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6
1933	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	—	—	—	—	—	—

AVERAGE MONTHLY PRICES OF EAST COAST HEMATITE AT MIDDLESBROUGH.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1917	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6
1918	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6
1919	122 6	122 6	122 6	122 6	179 2	190 0	197 6	200 0	200 0	200 0	200 0	200 0	171 4
1920	220 0	220 0	240 0	260 0	260 0	260 0	260 0	260 0	260 0	260 0	260 0	260 0	251 8
1921	240 0	220 0	180 0	180 0	180 0	160 0	160 0	160 0	137 0	127 6	117 6	104 6	162 2
1922	97 6	91 7½	100 0	98 6	97 1½	94 7	93 6	90 9	89 7	91 10½	93 0	93 2	94 5½
1923	94 6	104 9	122 0	126 10½	122 0	115 3	107 0	98 8½	98 10½	99 1½	100 6½	102 3	107 10½
1924	102 4½	101 3	99 7½	99 0	98 9½	97 4½	95 3½	93 1½	90 7½	88 0	88 4½	88 6	95 2½
1925	87 5	85 9	84 7½	82 6	80 10½	79 3	77 1½	75 7½	75 0	74 3½	74 9	76 0	79 5½
1926	77 3	77 9	77 3½	76 3	77 4½	78 0	79 8½	81 9	83 4½	87 7½	92 6	90 5½	81 7½
1927	90 9	90 0	86 3½	83 1½	80 6	78 0	76 6	75 4½	75 0	72 9	71 9	71 1½	79 2½
1928	69 7½	69 7½	69 9	70 0	70 0	69 3	68 7½	69 2	70 0	70 0	70 3	71 0	69 9½
1929	71 6	72 0	73 6	74 0	74 0	74 0	74 9	75 6	76 1½	76 8½	78 1½	79 0	74 11½
1930	78 2½	78 0	76 9	75 0	74 0	72 7½	71 0	71 0	71 0	71 0	70 10½	70 4½	73 3½
1931	70 0	69 0	68 0	66 8½	65 1½	63 4½	62 9	61 1½	65 0	65 0	65 0	65 0	65 6
1932	64 10	64 3	63 6	63 6	63 6	62 7½	62 0	60 6	60 0	59 3	59 0	59 0	61 10
1933	59 0	59 0	59 0	59 0	59 0	59 0	59 0	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.
13, RUMFORD STREET, LIVERPOOL.

PIG IRON

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,
CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.
ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

FOUNDRY Foreman wanted for a foundry in the Manchester district employed on general work, large and small, including plate and machine moulding. Describe experience fully and state salary required.—Box 474, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED, Working Foreman Coremaker, age 30 to 40, for malleable foundry; all classes of work. One accustomed to handling youths.—Applications, stating wages and experience, to Box 478, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOUNDRY and Patternshop Foreman requires position. Holds similar position at present with high-class firm. Up-to-date cupola practice, sand preparation, experienced light and heavy floor work, machine moulding. Accustomed to estimating. (222)

PROPERTY.

MAGNIFICENT

11 ACRES WORKS SITE.

SHEFFIELD.

145,000 Sq. Ft. of Shops.

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with L.M. & S. and L. & N.E. Rlys.

WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,

ALBION WORKS, SHEFFIELD.

MACHINERY

FOUNDRY Transverse Bar-Testing Machine by Avery, for 2-in. x 1-in. Bars, 1 to 3 ft. long, calibrated up to 40 cwts., with deflection scale; in good working order. Price £30 or nearest offer.—HARTLEY, SONS & COMPANY, Engineers, Etruria.

MACHINERY—*Continued.*

PNEUMATIC MOULDING MACHINES

No. 9 "Ajax" Jolt Turnover.
"Wallwork" Squeezer, 17½-in. x 12½-in. boxes.
"Tabor" Portable Jolt Rollover.
Four No. 1 Britannia Jolters.

HAND MOULDING MACHINES

Eight Standard-size Adaptables with Tail Guides.
Two Large-size Ditto, with Star handle, turnover and adaptable draw frame.
"Coventry" Headpress Squeezer Table, 22 in. x 30 in.
Four 36-in. Farwell Type Universal Squeezers.
Also
Pneulec Sand-drying Plant, 1 ton per hour, Sand Mills, Disintegrators, etc.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

THOS. W. WARD, LTD.

PUMPING SET, 3" Petrol-dr. Port. Diaphragm, cap. 4,500 galls. per hr.
SINKING PUMP, "Evans" Vert. "Cornish" D.A., cap. 20,400 galls. per hr. at 100 ft. per min.
GENERATING SET, 20-kw. Petrol-dr. Generator 110 volts, 750 revs.
BABCOCK W.T. BOILERS, 160 lbs. w.p.
5 NISSEN-TYPE STEEL BUILDINGS, 550' x 40' x 19 10" high.
Write for "Albion" Catalogue.
'Grams: "Forward." 'Phone: 23001 (10 lines).
ALBION WORKS, SHEFFIELD.

MISCELLANEOUS.

WANTED, large quantities of Clean "Y" Alloy and Duralumin Turnings of standard quality.—Full particulars with samples to Box 470, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

'Phone: 287 SLOUGH

HAND MOULDING MACHINES

Six Standard "Adaptables"	£12 each
24"×30" Darling & Sellars turnover	£15
Two 18"×16" Coventry HEADRAM squeezers	£18 each

PNEUMATIC MACHINES

24"×18" Tabor rollover, portable	£55
30"×20" Macdonald jolt rollover...	£60
20"×16" Macdonald jolt rollover...	£40
Britannia No. 0, 1 and 2 jolters ...	
No. 20 Macdonald plain jolter with 90"×90" table, jolts 8 tons	£160

AIR COMPRESSORS
ALL SIZES IN STOCK.

Every Machine overhauled and retested.

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

"COLBOND-ING"

is rapidly becoming Standard Foundry Practice.

Colbond, a finely pulverised natural mineral, affords a quick, cleanly and efficient means of reconditioning your old sand.

£7 . 10 . 0 per Ton at our Works.

For large quantities, ask us for a quotation.

Particulars from:

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Telephone: Sloane 4862.

FOR SCOTTISH IRONFOUNDERS.

FOUNDRY COKE
SPLINT COAL
SMITHY COAL

also

Hard Firewood for Kindling Purposes (in cut lengths 2' to 3') for Furnaces.

FOR QUOTATIONS—

Estab. 1870. **JOHN KNOX & Co.,** Telephone: Doug. 3506
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PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun, and on occasions—be it admitted—of naughtiness. Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception. Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed. There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

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